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Pacleobutrazol and Salicylic Acid Affects Salinity Resistance of Tomato under *in vitro* Condition

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Abstract: To investigate the effects of salicylic acid and paclobutrazol on induction of resistance to salt stress in tomato CV Falkato a completely randomized experiment with 5 replications was conducted in tissue culture laboratory of Mohaghegh Ardabili at 2010. Treatments include different concentrations of salicylic acid (0.01, 0.1 and 1 mM) and paclobutrazol (1, 2 and 4 μM) which applied in 50 or 100 mM of NaCl. Results indicated that lower concentrations of salicylic acid and paclobutrazol are able to increase salinity resistance of tomato in case of seed germination and seedlings growth stages, while the highest level of these compounds (1 mM of SA and 4 μM from PBZ) inhibited seed germination in 100 mM of NaCl salinity. Leaf numbers, shoot and root fresh weight increased by salicylic acid and paclobutrazol treatments in medium containing 50 mM of NaCl. In general results revealed that salicylic acid and paclobutrazol could enhance seedling performance under salinity condition.

Key words: Falkato · Fresh weight · Germplasm selection and seedling performance

INTRODUCTION

Tomato is one of the most important world vegetable crops. Growth and development of this crop affected negatively by abiotic stresses. Salinity as an abiotic stress is most important limiting factor for crop production. Salinity reduces plant growth and alters ionic relations by ionic and osmotic effects [1]. Also salinity has unfavorable effects on photosynthetic performance of plant by increases in stomatal resistance and inhibition the biosynthesis of photosynthetic pigments. In general salinity inserts its negative effects by reduction of water uptake and accumulation of toxic elements [2]. Paclobutrazol (PBZ) is a triazole plant growth retardant compound [3], which affects root [4], shoot [5] and leaf [6] growth, photo assimilate allocation [7] in plants and in vitro tuberization [7]. The positive effects of paclobutrazol in alleviating the adverse effects of abiotic stress have been reported.

Salicylic acid is new classes of plant growth substances, which participates in regulation of some physiological processes in plants such as flowering and ion uptake by roots. This compound induces of thermogenesis in Arum lily naturally and serves as a signal in the induction of expression of pathogenesis related protein (PR) [8]. Application of SA modulates antioxidant enzymes activities, which confers resistance to abiotic stresses in plants [9]. Also, SA induced synthesis of heat shock proteins in tobacco plants and increased wheat seedling resistance to high temperature stress [8].

Plant selection for resistance to abiotic stresses and field- study of chemical agent on plant responses are very complex and time-consuming process. Hence, uses the in

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vitro screening is an effective approach to germplasm selection in short time and high accuracy. There are many report's that indicates, *in vitro* screening is effective in cultivar selection against abiotic stress, for example grape cultivars against to drought stress Cran-berry cultivars to osmotic stress, potato cultivar against drought stress [10]. The aim of this investigation is evaluation of SA and PBZ effects on enhancing salinity resistance in tomato seedling under *in vitro* condition.

MATERIALS AND METHOD

Tomato seeds cv falkato were used as explants cultured in tissue culture laboratory of Mohaghegh Ardabili. For obtaining sterile culture seeds leached with running water for 15 minutes and disinfested by % 70 ethanol and % 3 sodium hypochlorite for 45 second and 20 min respectively, then seeds was leached three-time with distilled water.

MS medium supplemented with % 3 sucrose, % 0.8 Agar and either 50mM or 100mM NaCl was used for salinization of cultural medium. Treatments were comprised from different concentration of salicylic acid (0.01, 0.1 and 1 mM) and paclobutrazol (1, 2 and 4 μm). Cultures were kept at 25°C temperature and 16/8 day/night photoperiod in growth chamber.

After two month seedling growth indices include leaf number, shoot and root fresh weight and shoot length were recorded. This experiment was carried out in completely randomized design with 10 treatments and 5 replications. Data were subjected to analysis of variance by SPSS 16.0 software and means were separated by Duncan multiple range test at 0.05.

RESULTS

Leaf Number: SA and PBZ increased seedling leaf numbers under both salinity levels (50 and 100 mM NaCl) (Fig. 1). Under moderate salinity SA at 1 and 0.01 mM concentration significantly increased leaf number but under high salinity level, 0.01 and 0.1 mM of SA had similar effects. This compound at 1mM concentration had not any effects on leaf numbers under 100 mM salinity. At lower concentration (1, 2 μm) of PBZ leaf numbers increased under both level of salinity. But this compound didn't affect seedling leaf numbers at 4 mM.

Shoot Length: All concentrations of PBZ decreased shoot length in 50 mM salinity, while under 100mM NaCl salinity level, PBZ(1 and 2 μM) increased this trait in comparison to control because of inhibition of seed germination in control (only by 100 mM NaCl). Also, in media containing 50 mM of NaCL shoot length was decreased at 0.1 and 0.01 mM of SA in contrast to control significantly, but SA enhanced seed germination, consequently shoot length under higher salinity level, (Fig. 1). The highest concentration of SA had no effect on shoot length in saline condition.

Shoot Fresh Weight: Lower concentrations of SA in media increased shoot fresh weight under 50 mM salinity level (Fig. 1). Under 100 mM salinity level, seedling obtained from media containing 0.01 mM of SA increased shoot fresh weight in comparison to control and other concentrations of SA.

Shoot fresh weight was increased by all concentrations of PBZ in media containing 50 mM of NaCl. But under high salinity level, shoot fresh weight increased only at 1 and 2 μM of PBZ.

Root Fresh Weight: In 50mM of NaCl salinity media treated with PBZ produced higher fresh weight of root in comparison to control, while Under high salinity level only 1 and 2 μM concentrations of PBZ enhanced seed germination consequently root fresh weight (Fig. 1).

Salicylic acid at 0.01 mM increased root fresh weight under both salinity levels, significantly, whereas under high salinity level, as increase in salicylic acid concentration, root fresh weight was reduced.

DISCUSSION

Results indicated that PBZ enhanced seedling performance under salinity condition. treatment with various concentrations of PBZ on media containing of 50 mM of NaCl, produced vigorous seedling in contrast to control, while shoot length decreased in PBZ treatments.

Under high salinity, PBZ at 1 and 2 μM increased leaf number, shoot and root fresh weight and shoot length, because of enhancement of seed germination. There are many reports that PBZ increased plant resistance against salinity and other abiotic stress in crops such as wheat. Also it has been reported that PBZ increased plants resistance to stresses by increasing antioxidant activities, moreover PBZ can inhibit ABA degradation which induce

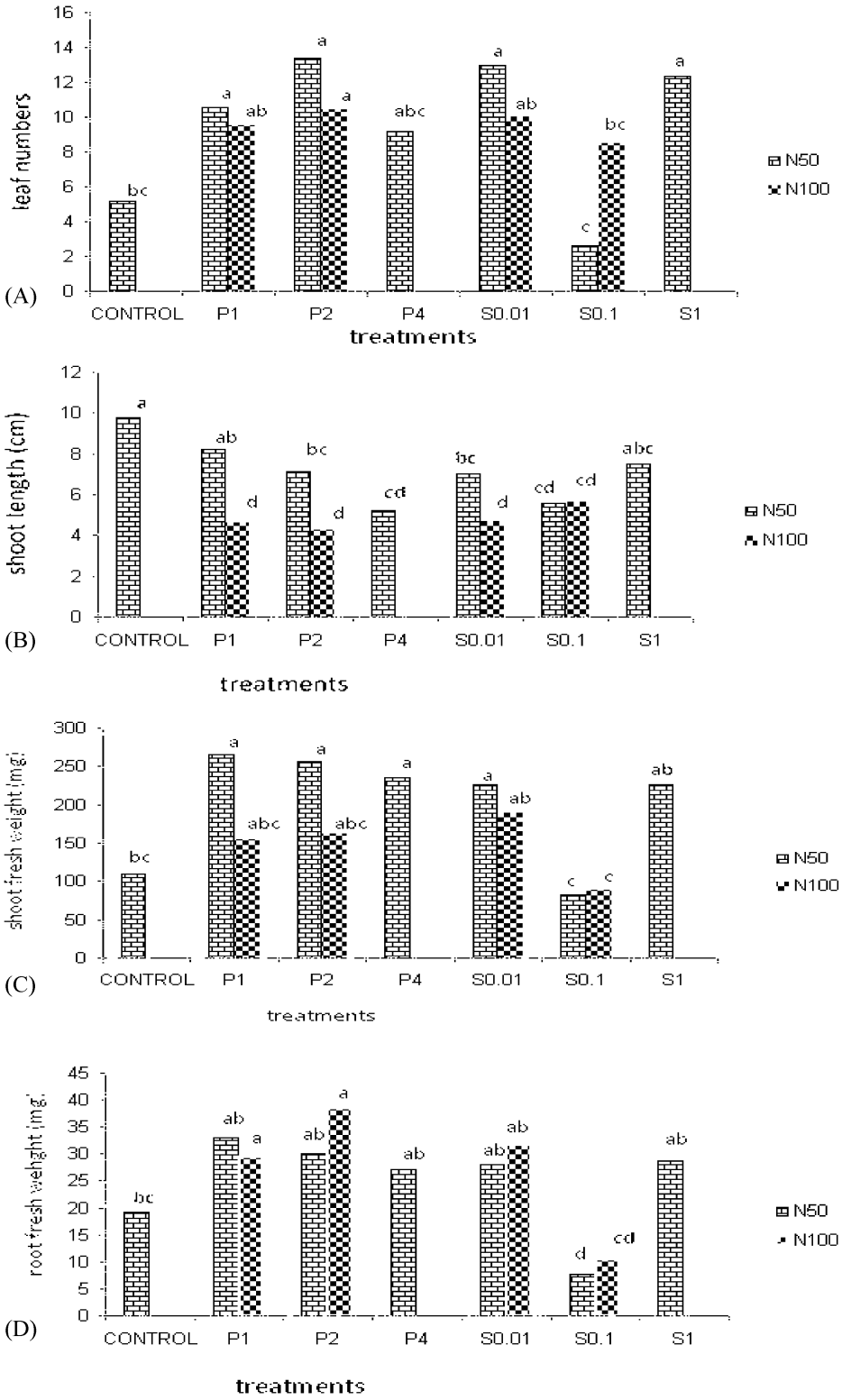

Fig. 1: Effects of Salicylic acid and paclobutrazol on tomato leaf numbers (A); shoot length (B); shoot fresh weight (C) and root fresh weight (D).
Note: SA, P and N indicating salicylic acid, paclobutrazol and NaCl, respectively.

anti-stress reaction in plants [11]. Inhibitory effect of PBZ on shoot growth (length) can be attributed to antigibbelin activities of this compound [12].

Also, Results indicated that SA is capable to increase seedling performance under salinity stress. But high levels of this compound showed inhibitory effect on seed germination. There are several evidences which prove the positive effects of SA on various plants under stress condition. For example maize and mustard treatment by salicylic acid increased seedling tolerance to chilling and high temperature condition [13]. Also anti-stress effects of salicylic acid has been shown in rice [14], wheat [15] and beans [8]. SA priming of seeds resulted in increase in growth and dry weight of rice root [14] and SA growth promoting properties are reported in barley roots under cadmium stress [16].

The mechanism of SA effects in alleviating of harmful effect of abiotic stress have been attributed to increasing anti-oxidative enzymes and change in cell wall metabolisms, also sa treatment induces ABA accumulation, which induced anti-stress reaction in plant [8]. Moreover, the mechanism of SA in inducing resistance to environmental stresses is lied on its ability to express genes that code for PR-proteins [17].

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