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Ameliorative Effects of Salicylates on Germination and Chlorophyll On Salt Stressed *Zea mays* L.

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ABSTRACT

Germination rate and chlorophylls (a and b) were assayed in salinized grains and seedlings. Results indicated that salinity caused obvious reductions in germination and chlorophylls. Supplements of salicylic acid and its derivatives (Acetyl salicylic acid and Methyl salicylate) partially alleviated the depressive effects of salinity and germination, and unexpectedly raised the chlorophylls above controls in the salinized seedlings. Results are interpreted as indicating a positive correlation of salicylic acid and its derivatives on salinized grains and seedlings of maize.

INTRODUCTION

The two major environmental factors that currently reduce plant productivity are drought and salinity (Serrano et al., 1999). Salinity is one of the major obstacles to increasing production in crop growing areas throughout the world. In spite of the extensive literature, there is still a controversy with regard to the mechanism of salt tolerance in plants (Neumann, 1995). Salinity impairs seed germination, reduces nodule formation, retards plant development and reduces crop yield (Greenway and Munns, 1980). In the past few years different approaches and strategies were used to mitigate the depressiveeffects of high salinity on growth and key parameters on plants growing in saline soils.

Salicylic acid is a phenolic compound which despite its broad distribution in plants has basal levels differing widely among species with up to 100-fold differences have been recorded (Raskinet al., 1990). In recent years salicylic acid has been the focus of intensive research due to its function as an endogenous signal mediating local and systemic plant defense responses against pathogens. It has also been found that salicylic acid plays a role during the plant response to different abiotic stresses such as drought, chilling, heavy metal toxicity, heat and osmotic stress. Salicylic acid plays a crucial role in the regulation of physiological and biochemical processes during the entire lifespan of the plant (San Vicente and Plasenica, 2011).

The present study was initiated to investigate the influence of salinity on germination and chlorophyll content in maize, and to evaluate the effect of supplements of salicylic acid and its derivatives on the two tested parameters.

MATERIALS AND METHODS

Estimation of the germination rate:

Filter paper disks were placed on the bottom of Petri dishes. Then, 25 grains (var. Mugtyama 45) were placed on each dish. The following solutions (5ml each) were pipette on the grains as listed below:

Dish 1: Distilled water (control).

Dish 2: NaCl solution (50mM).

Dish 3: Equal volumes of NaCl solution and Salicylic Acid (5mM).

Dish 4: Equal volumes of NaCl solution and Acetyl Salicylic Acid (5mM).

Dish 5: Equal volumes of NaCl solution and Methyl Salicylate (5mM).

The grains were allowed to germinate in laboratory conditions (grains were considered to be germinated with the emergence of the radicle.

Plant culture:

Grains of *Zea mays*L.were first disinfected with 0.5% sodium hypochlorite solution for 5 min., and then washed several times with distilled water and germinated in pots under greenhouse conditions. The pots contained sand and clay (1:1), and watered daily. After three weeks, the pots were divided into 5 sets as follows:

1. Control.
2. Salinized with 50mMNaCl.
3. Salinized with 50mM NaCl + 5mM Salicylic Acid (SA).
4. Salinized with 50mM NaCl + 5mM Acetyl Salicylic Acid (ASA).
5. Salinized with 50mM NaCl + 5mM Methyl Salicylate (MS).

The salinity solutions were irrigated in the rooting medium, whereas the salicylates were foliar applied. Five days later, leaves of all treatments were assayed for chlorophylls (a and b).

Estimation of chlorophyll a and b:

The method used was that described by Strain and Svec, (1966). One gram of fresh leaves is ground with 40 ml of acetone solution (80%) in a clean mortar. The green liquid is carefully transferred to Buchner funnel with Whatman filter paper No. 1. The residue is further extracted twice with acetone solution, and filtrates were collected and made with acetone solution to 100 ml. The absorbance of the green solution is read at 645nm against a solvent bank. The chlorophyll content is calculated as follows:

Chlorophyll a mg/ml = 11.46 x A 663 – 2.16 x A 645.

Chlorophyll b mg/ml = 20.97 x A 645 – 3.9 x A 663.

RESULTS & DISCUSSION

Results presented (Fig. 1) revealed that the germination of the maize grains was strongly affected by the salinity treatment. It is assumed that in addition to toxic effects of certain ions, higher concentration of salt reduces the water potential in the medium which hinders water imbibition by germinating seeds/grains, and this reduces germination (Mass, 1986). It is expected that germination rate decreases with the reduction of water movement into the seeds/grains during imbibitions (Hadas, 1977). Salt induced inhibition of seed germination could be attributed to osmotic stress, or to specific ion toxicity (Huang and Redman, 1995). Results obtained in this study are consistent with Jeannette et al., (2002) who reported decline of germination rate in salt-stressed seeds of *Phaseolusvulgaris*.

The chlorophylls (a and b) were reduced as a result of salinity treatments relative to controls. The decrease in chlorophyll content under saline conditions is reported by Iqbal et al., (2006), Ashraf and Foolad, (2005) and Nazarbeygi et al., (2011). Many environmental factors control chlorophyll synthesis in plants. Salinity stress decreases chlorophyll content of the plant by increasing the activity of the chlorophyll degrading enzyme chlorophyllase (Rao and Rao, 1981), inducing the destruction of the chloroplast structure and the instability of pigment protein complexes (Dubey, 1997). In this study, salinity distinctly reduced the germination rate (Fig. 1) and the chlorophylls a and b (Fig.2). But, supplements of salicylic acid and its derivatives partially alleviated the deleterious effects of salinity on germination, and unexpectedly increased the chlorophylls above control values.

The data presented show that salicylic acid and its derivatives could protect maize plant from the depressive effects of salt-stress by improving the two physiological parameters tested. It is suggested that salicylic acid and its derivatives could be used to overcome damages generated by salinity stress, enhance salt tolerance and regulate plant growth and development.

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التأثير الإيجابي للساليسيلات على الإنبات والكلوروفيل في الذرة الشامية الناميه تحت ظروف الملوحة.

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تم تقدير نسبة الإنبات والكلوروفيل في حبوب الذرة الشامية والبادرات المعاملة بالملوحة وأظهرت النتائج انخفاضا واضحاً للمتغيرين. إضافة حمض الساليسليك ومشتقاته (استيل حمض الساليسليك وساليسيلات الميثيل) خفضت جزئياً الأثر الضار للملوحة على الإنبات بينما ادت الى زيادة محتوى الكلوروفيل مقارنة بالبادرات الضابطة. أظهرت هذه النتائج وجود تأثير إيجابي لحمض الساليسليك ومشتقاته على حبوب الذرة الشامية وبادراتها التي تعرضت للملوحة.