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Research Article

EFFECT OF CARBONATES ON SEED GERMINATION AND SEEDLING GROWTH IN *PORTULACA OLERACEA* L.

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ABSTRACT

One of the most important stresses is alkali stress that effects plants growth and metabolism. The effect of carbonates ($NaHCO_3$, $KHCO_3$ and $(NH_4)_2CO_3$) on seed germination and seedling growth in *Portulaca oleracea* L. was investigated. Germination percentage was decrease with increasing concentration of salts. Root length and dry weight were strongly reduced due to carbonate salts. Shoot length and fresh weight were slightly increased at lower concentration (25mM) of salts and then decreased at higher concentrations (50, 100, and 200mM). From the results, it appears that *P. oleracea* L. is rather sensitive to carbonate salts during germination and seedling growth.

Keywords: Seed gernimation, carbonates, alkalinity stress *and Portulaca oleracea* L.

1. INTRODUCTION

Salinisation of soil has become global environmental problem an important factor limiting agricultural productivity. In saline environment adaptation of plants to salinity during germination and early seedling stage is crucial for establishment of species [1]. Salt stress decreases growth in most plants including halophytes. When a saline soil contains HCO_3^- and/or CO_3^- which elevate soil pH, plant experiences damages from both salt and alkali stress [2].

The high pH environment that surrounds the roots can cause metal ions and phosphorus to precipitate [3]. The problem of alkalization due to $NaHCO_3$ and Na_2CO_3 may be more severe than the problem of salinization caused by the neutral salts such as NaCl and Na_2SO_4 [4].

Salinity impairs seed germination, reduces nodule formation, retard plant development and reduces crop yield [5]. Germination and seedling characteristics are the most viable criteria used for determining salt tolerance in plants [6]. Seed germination and seedling growth are reduced in saline soil with varying responses for species and cultivar [7]. It is usually the most critical stage in seedling establishment [5, 6]. Salinity stress negatively affects seed germination, either osmotically through the accumulation of sodium and chloride causing an imbalance in nutrient uptake or the toxicity effects [7]. Seed germination, seedling emergence and its survival are particularly sensitive to substrate salinity [8, 9].

Portulaca oleracea (Purselane) is an annual plant from portulacaceae [10]. It is the main weed for 45 cultivating types in 81 countries of world [11]. Life cycle of this plant is completed during 2 to 4 months [12]. The aim of the present study was to evaluate the effects of carbonates ($NaHCO_3$, $KHCO_3$ and $(NH_4)_2CO_3$) on germination and early seedling growth.

2. MATERIAL AND METHODS

Seeds of *Portulaca oleracea* L. were collected from the fields of village Kaulage of Kolhapur district. They were surface sterilized with 0.5% sodium hypochloride for 1 min, washed first with a jet of tap water and then with sterile distilled water and air dried. The air dried seeds were kept in a sterilized petridish for germination using germination paper, moistened with 5ml of distilled water or with treatment solutions [25, 50, 100, 200mM concentrations of each $NaHCO_3$, $KHCO_3$, and $(NH_4)_2CO_3$]. The petridishes were kept in the dark for germination. Each treatment had three replicates. Germination percentage was measured after every 24 hours for five days and root length, shoot length and fresh and dry weights of seedlings were measured after 120 h.

3. RESULTS AND DISCUSSIONS

Effects of carbonates on germination and seedling growth (Germination percentage, root length, shoot length, fresh and dry weights) have been depicted in Figures 1 to 5.

It was found that the germination percentage was significantly reduced in all treatments as compared to that in control. Seed germination was totally inhibited at higher concentrations of all carbonates. It was decreased with the increase in $NaHCO_3$, $KHCO_3$ and $(NH_4)_2CO_3$ salts concentrations. Only 16.66% ±2.887 seeds were germinated at 25 mM $(NH_4)_2CO_3$, whereas 32.33% ±3.055 seeds in KHCO3 and 21.67%±11.547 seeds in $NaHCO_3$ were germinated. Germination percentage was decreased in all treatments in the following order Control≥$KHCO_3$≥ $NaHCO_3$≥$(NH_4)_2CO_3$.

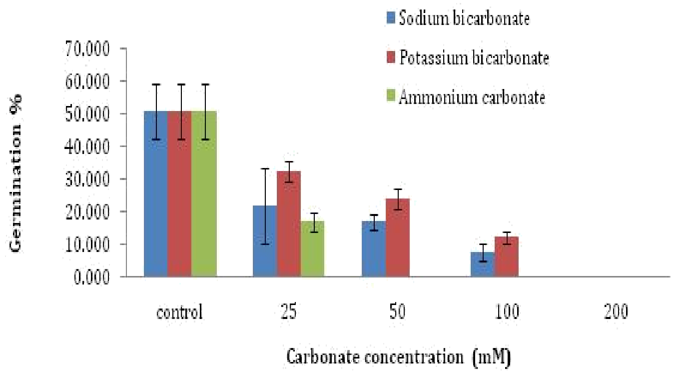

Figure 1: Effect of carbonates on germination percentage in Portulaca oleracea L

Root length was decreased with increasing in concentration of carbonate salts. Highest root length was recorded in control (1.120 ±0.253cm). Maximum decrease in the root length was observed in $KHCO_3$ (0.199 ± 0.088) at 50 mM, 0.420 ± 0.123 cm in $NH_4)_2CO_3$ and 0.389 ± 0.078 cm in $NaHCO_3$ at 50 mM concentration.

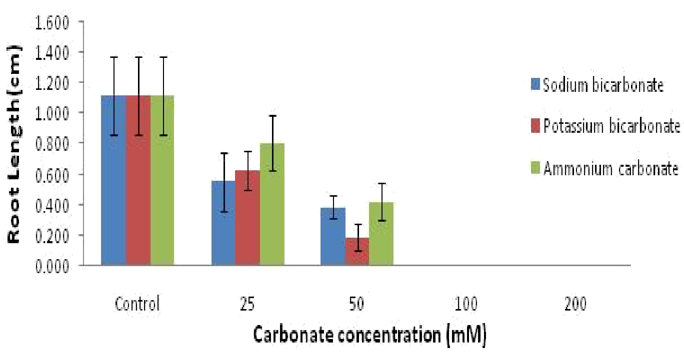

Figure 2: Effect of carbonates on root length of Portulaca oleracea L. seedlings.

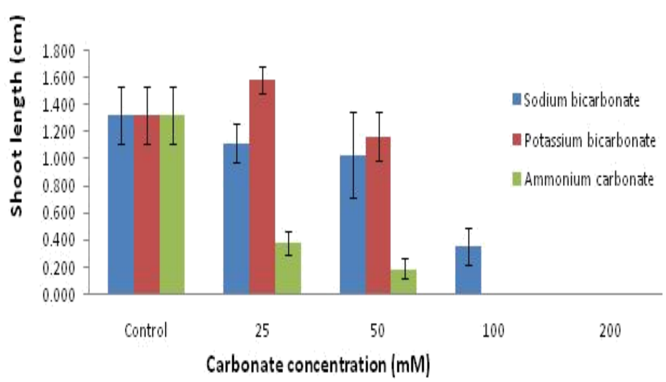

Figure 3: Effect of carbonates on shoot length of Portulaca oleracea L. seedlings

Higher shoot length of seedlings was observed in $KHCO_3$ at the lower concentration (25 mM 1.595 ±0.099cm) than that in control (1.322±0.211cm). It was significantly decreased due to $NaHCO_3$ and $(NH_4)_2CO_3$ salinities. It was severely affected by $(NH_4)_2CO_3$ (0.190 ± 0.074cm)as compared to that by $NaHCO_3$ (1.033 ± 0.320cm) and $KHCO_3$ (1.170 ± 0.177cm) at 50 mM salt concentration. The negative effect of carbonate salts on shoot length of this plant can be given in the order $KHCO_3$≤ $NaHCO_3$≤ $(NH_4)_2CO_3$.

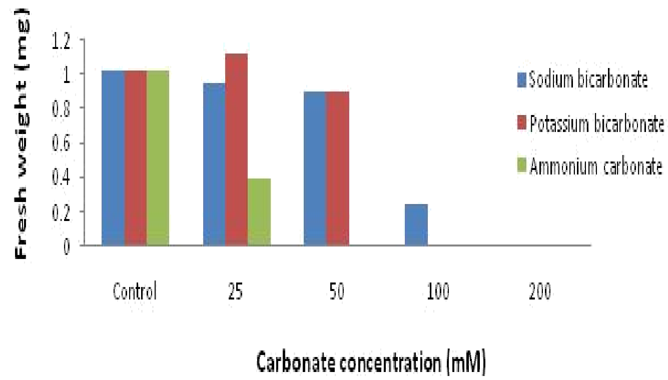

Figure 4: Effect of carbonates on fresh weight of Portulaca oleracea L. seedlings

Fresh weight of *Portulaca* seedlings was decreased with increase in the concentration of carbonate except $KHCO_3$. At 25 mM $KHCO_3$ the seedlings fresh weight was slightly increased (1.13 mg) over the control (1.03mg). Dry weight of seedlings was not significantly decreases in lower concentration of $(NH_4)_2$ CO_3 and $KHCO_3$, but at higher concentration of salts (50 and 100 mM) it was negligible.

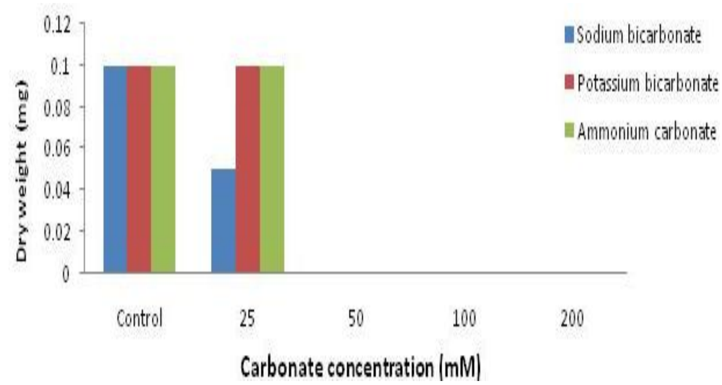

Figure 5: Effect of carbonates on dry weight of Portulaca oleracea L. seedlings.

4. DISCUSSION

Salinity is a major environmental stress factor that affects seed germination in costal marshes [13]. Seed germination of *C. glaucum* was decreased with increase in NaCl, Na_2CO_3, Na_2SO_4, $MgSO_4$ and MgCl concentration in medium [14]. Germination percentage in Thyme (*Thymus vulgaris* L.) seeds was found decreased at all salinity levels [15]. The salinity stress affects germination in a variety plants which can infer to meaningful decreasing on *Vigna radiate* L. and *Lens culanuris* [16]. Salt stress inhibited the seedling growth and root length was more affected than shoot length [17]. Germination percentage of *Portulaca oleracea* L. was decreased in all imposed salinity levels and the highest germination percentage was observed in control [18]. The dry mass of leaves, stems and roots of sunflower seedlings was decreased with increasing stress intensity; the reduction under alkaline conditions was greater than that under saline conditions [19]. Seedling emergence, fresh and dry mass of both shoot and root as well as seed yield were decreased with increasing salinity [20]. No seed was germinated at the concentration of 250mM NaCl in case of *Portulaca oleracea* L [21]. The fresh weight of germinated seed was significantly modified, under the influence of salt stress at different levels in *Vigna unguiculata* Cv. Pitiuba [22].

5. REFERENCES

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