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The Influence Salinity and Seed Pre-Treatment on the Germination of German Chamomile (*Matricaria chamomilla* L.)

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Abstract: The germination of *Matricaria chamomilla* seeds was studied under controlled environmental conditions. Interactive effects of salinity and different pre-treatments of seeds were evaluated. Chamomile seeds were placed in Petri dishes with filtration paper and the germination and radical development followed during seven day periods. Salinities up to 100 mM NaCl did not influence the germination percentage, but at 200 and 250 mM germination was reduced to 29 and 17%, respectively. Pre-treatment of seeds in hot water, sulphuric acid or calcium sulphate had only minor effect on germination rate.

Key words: Salinity, germination, acid pre-treatment, hot water pre-treatment, Chamomile

INTRODUCTION

German chamomile (*Matricaria chamomilla* L.) which belongs to the *Asteraceae* family, is a very important medicinal plant (Bradley, 1992; Hornok, 1992; Mann and Staba, 1992). Pharmacological properties of chamomile includes anti-inflammatory, antiseptic, carminative, healing, sedative and spasmolytic activity (Isaac, 1989; Salamon, 1992; Pirzad *et al*., 2006).

Uniform stand establishment for chamomile production is essential to maintaining profitable yields. Poor stands are a result of many factors, including seed quality, environment, water and soil quality, site preparation, plant uniformity, irrigation practices and other management practices. This study focused on 2 critical environmental factors: salinity and pre-treatment of seeds. Learning to manage them is crucial to producing profitable yields (Shonjani, 2002).

Salinity of soil and irrigation water is a continuing threat to economic crop production especially in aried and semiaried regions of the world (Kayani *et al*., 1990). The ability of seed to germinate in saline environments and seedlings to survive in saline conditions are critical for crop production in saline soils (Maranon *et al*., 1989; Rhoades *et al*., 1992).

In addition, many seeds have thick seed coats which keep water out of the seed, so the embryo cannot get the water needed to activate its metabolism and start growing (Smith and Bent, 1993). Various pre-treatments of the seeds such as nicking, hot water soaking and physical or acid scarification have been used to enhance the germination of many species (Smith and Bent, 1993). It is important to know seed germination requirements of chamomile, in order to understand the possible role of different environmental factors for the establishment in nature. Therefore, this study was conducted to elucidate the effects of various environmental factors as well as salinity and seed pre-treatment options on chamomile germination.

MATERIALS AND METHODS

Seed material: Seeds of chamomile tetraploid variety Bodegold, a chamazulene-high mixed type with a high content of bisabolol, provided from Germany, were used in present study.

Effects of salinity: The effects of seven salt concentrations (0, 25, 50, 75, 100, 200 and 250 mM NaCl) at a 30°C: 20°C day: night cycle were tested in a controlled environment system at 7 days. Twenty five seeds of uniform size were placed in a Petri dish with filter paper and ten millilitres of different salt concentration (NaCl). All the seeds were checked daily for germination during seven days after which no seeds germinated.

Effects of pre-treatment: The effects of five different pre-treatments (H2SO4 98%; CaSO4 1 mM; CaSO4 10 mM; soaking in 60°C water; soaking in 70°C water) at a 30°C:20°C day: Night cycle were tested in a controlled

environment system at Ecology and Medicinal Plants Laboratory of the University of Tabriz. Thirty seeds of uniform size were placed in a Petri dish and the pre-treatment solutions for 10 min. Then the seeds were rinsed with distilled water and placed in Petri dishes on filter paper and ten millilitres of distilled water. All the seeds were checked daily for germination during 8 days after which no seeds germinated.

RESULTS AND DISCUSSION

Effects of salinity: Salinity significantly affected the percentage germination of Chamomile (Fig. 1). At salinities up to 100 mM NaCl the germination rate was in the range of 41-50%. At 200 mM germination rate was only 29% and at 250 mM only 17%. The germination began already at day 1 at salinities up to 100 mM but no seeds germinated until day 3 in the 200 and 250 mM salinity treatments (Fig. 2). After 3-4 days the germination was almost complete in all treatments and only few additional seeds germinated until day 7 when the experiment was terminated.

Effects of pre-treatment: The effects of the five different pre-treatments on chamomile seed germination are shown in Fig. 3. The germination percentage was 37-53% and did not differ much between the treatments. Germination of seeds pretreated with 70°C hot water was significantly higher than germination of seeds pre-treated with 60°C water and seeds pre-treated with 98% H2SO4, but generally differences were small. Germination started already day 1 in all treatments and increased the following days (Fig. 4). After one week no more seeds germinated.

Salinities of 200 mM NaCl and higher which is equivalent to approximately 1/3 strength seawater, significantly decreased the germination rate of *M.chamomilla* seeds. The negative water potential in saline water diminishes the influx of water into the seeds and hence impedes germination (Thompson and Grime, 1983). The reduced rate of water uptake also affects the timing of the germination. In low salinity treatments water uptake and germination occur very fast, within one to two days, whereas at high salinities germination was not recorded until after 3 days. High concentrations of Na and particularly Cl ions can also have a direct toxic effect on the cells (Roundy, 1987). It must, however be noted, that germination was not affected at salinities up to 100 mM (equivalent to 5.8 ppt) and even at the higher 200 and 250 mM salinities, seeds did germinate. This shows that chamomile seeds are able to tolerate some salinity and germinate on slightly saline soils. In the

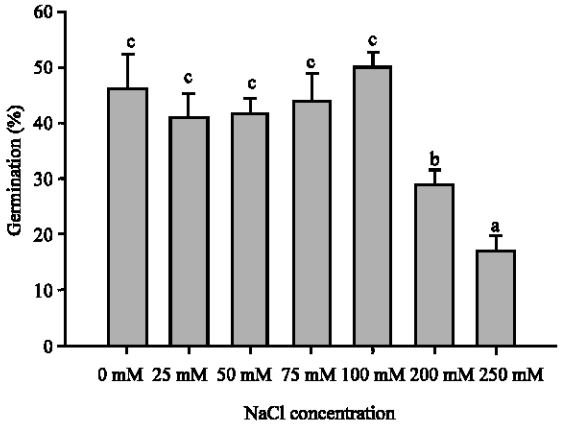

Fig. 1: The effects of different NaCl concentrations on the germination of chamomile seeds (n = 5, mean and standard error). Different letters above columns indicate significant differences ($p<0.05$) between salinities

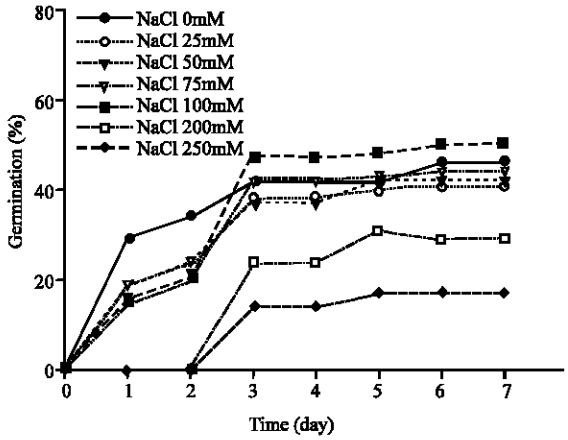

Fig. 2: Percent germination of *Matricaria chamomilla* seeds at different NaCl salinities during seven days

present study the pre-treatment options tested only resulted in minor effects on the germination rate. Soaking seeds in hot 70°C water for 10 min increased the germination rate by approximately 20% compared to the other treatments, but germination rates (about 50%) were generally at the same level as in the salinity experiment. The soaking of seeds in hot water is a cheap and easy method of softening the seed coat and stimulate water uptake by seeds of many species (Smith and Bent, 1993). The fact that only small effects of the pre-treatments were found indicates that the chamomile seed germination is not significantly restricted by a hard seed coat that inhibit water uptake.

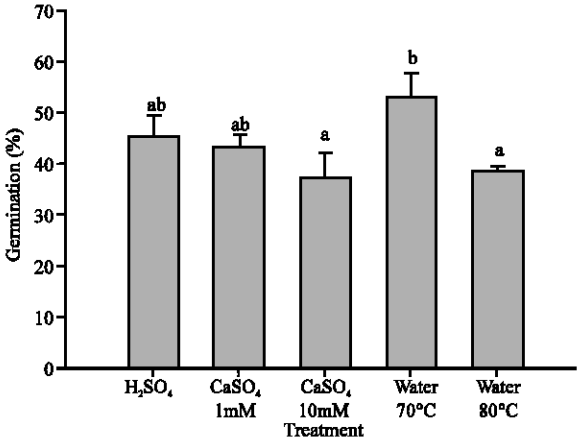

Fig. 3: Effects of different pre-treatments on seed germination rate of *Matricaria chamomilla* (n = 5, mean and standard error). Different letters above columns indicate significant differences ($p<0.05$) between treatments

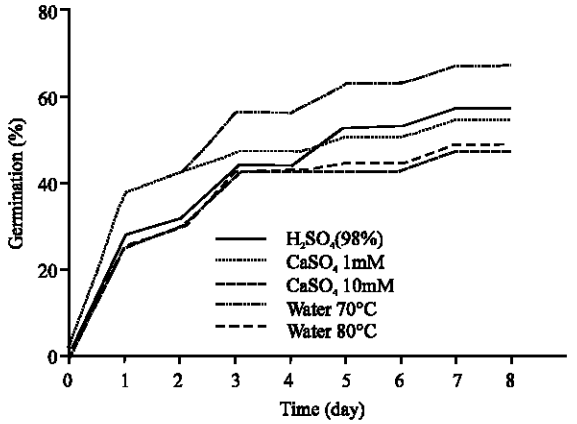

Fig. 4: Percent germination of *Matricaria chamomilla* seeds exposed to different pre-treatments during eight days

CONCLUSION

Germination occurs readily at salinities up to 6 ppt, but at higher salinities germination rates are lower. Pre-treatment in hot water, sulphuric acid or calcium sulphate to soften the seed coat has only minor effect on germination rate.

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