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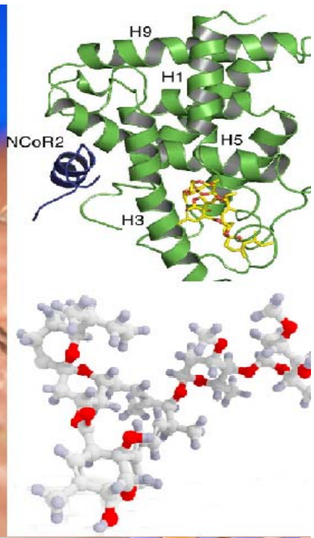

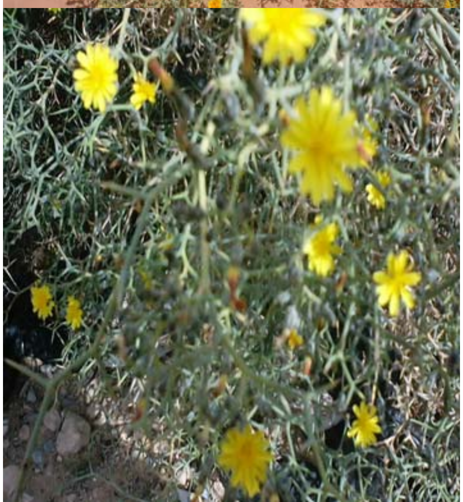

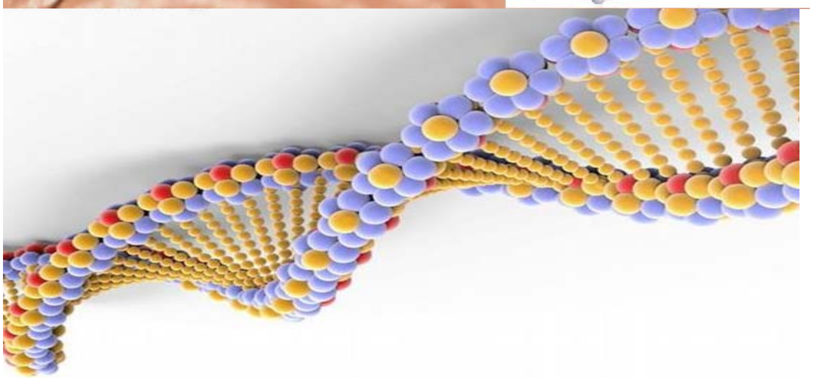

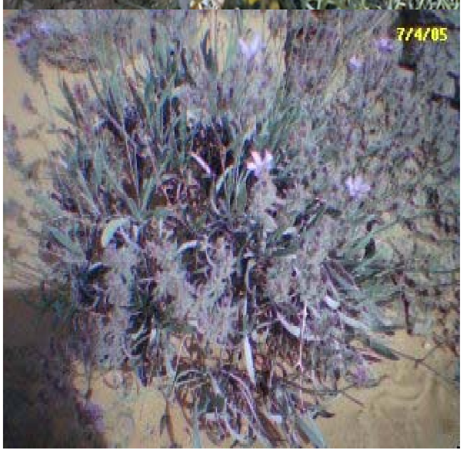

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Effect of hydrous and saline stress on seeds of *Chamaerops humilis* L. at the stage of germination

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Abstract. *In order to later consider a conservation and rehabilitation program, as necessary to evaluate the effect of the main environmental constraints affecting the germination of seeds of Chamaerops humilis L., including drought and salinity. For this purpose, we subjected seeds to various concentrations of NaCl (0 to 200 mM) and of PEG 6000 (0 to 200 g/l). The Germination is evaluated by the cumulated seed rate germinated during one 60 day period. The analysis of ANOVA highlighted an effect treatment (concentration of PEG and NaCl) highly significant on the rate of germination (p≤0. 05). The response of seeds of Chamaerops humilis to the hydrous and saline stress varies in time with the concentration in PEG and NaCl although it reduces the rate and the speed of germination expressed compared to the witness. Nevertheless, this study shows as well as the germinative capacity of Chamaerops humilis with respect to the abiotic constraints is undoubtedly sufficient to retain in the projects of improvement of the pastoral cures and fight against the turning into a desert and to widen consequently its surface of distribution.*

Key Words: *Chamaerops humilis* L., Saline stress, Hydrous stress, Germination

1. Introduction

Since more than one decade, the biological consequences of the world climate changes alerted the whole of the scientific community [1-3]. Indeed, a recent scenario of evolution of the world biodiversity indicates that the Mediterranean basin represents one of the eco-regions should undergo the most drastic changes of biodiversity at the dawn of year 2100 [3]. Algeria is part of the group of the Mediterranean countries. These two natural constraints, the drought and salinity, modified the stability of the ecosystems [4] and are mainly the causes of the desertification of the grounds [5]. Under these conditions, the physiology of the plants is disturbed [6-7] and are in large part the causes of desertification of soils [5]; certain spontaneous species disappeared; others are threatened of disappearance [8] and of fall of the outputs [9-10]. With the gleam of these

pessimistic indications, it appears legitimate to wonder about the biological and ecological impacts induced by these stressing environmental conditions on the one hand, and to understand the mechanisms concerned by the plants to adapt to these new environmental conditions. To contribute to the rehabilitation of the affected regions by the aridity and for better fighting against this phenomenon, it is necessary to seek the solutions which make it possible to improve vegetable cover and to solve the problems of regeneration of certain vegetable gasoline's in arid regions, particularly *Chamaerops humilis* (*C. h.*) which is threatened in certain parts of the area of Tlemcen (Western Algeria) [11]. This species held our attention, because it can develops on all soil types, having a system root very developed fixing the road bases of the ground and can be used like means of fight against the erosion of the grounds and the desertification. Compared to the high pharmaceutical value ethno of this taxon [12-15], it is important to control the environmental conditions of its germination to evaluate and limit.
This work aims at the study of the effect of the principal environmental constraints affecting the germination of the seeds [16-17], in particular of the drought and salinity [18-19] which blocks the tests of restoration of the threatened plant species. In this context, we are leaning on the study of germination in conditions of saline and hydrous stress in order to understand the variability of the germination of seeds of *Chamaerops humilis*.

2. Material and Methods

2.1. Plant material

The seeds of *C. h.* were collected on feet of Chamaeropaies, located in the zone of Beni Snous (mounts of Tlemcen), area with Mediterranean climate. The seeds used are selected carefully after a morphological sorting and by using the test of floating to determine viable seeds and their physiological maturity.

2.2 Experimental protocol

2.2.1. Effect of salinity on germination

The seeds selected are peeled their teguments, sterilized during a few minutes in a solution at 1% of hypochlorite of sodium and rinsed additional amount with distilled water. They are then sown in Petri dish 9 cm in diameter and 1.3 cm thickness and are deposited in a regulated plant laboratory with 25°C. Each experimental test relates to 100 seeds at a rate of 5 repetitions of 20 seeds per Petri dish. In each box of kneaded 10 ml of distilled water is versed for pilot seeds and 10 ml of saline solution (NaCl) to various concentrations: 5, 25, 50, 100, and 200 mM for stressed seeds.
The duration of the test was fixed at the period of germination which was spread out over 60 days; the counting of germinated seeds is made daily.

2.2.2. Effect of the hydrous stress on germination

The experimental device of germination of seeds of *C. h.* is the same one as the precedent. The tests of germination were carried out under various levels of hydrous potential simulated using a Polyethylene solution glycol (PEG_{6000}). The PEG constitutes agent relatively stable, inert, nonionic, but quite water soluble. It is not poison even with strong concentrations and the optimal temperature of the germination 25C°. The PEG maintains a potential hydrous stable and uniform during all the experimental period. Indeed, the molecules of PEG_{6000} constitute a more effective means to simulate a hydrous constraint. The choice of this osmotic agent is justified by its advantages that is to say a product inert, neutral, not affecting the pH and having a raised molecular weight. It does not penetrate in seeds and does not seem to have interferences nor side-effects [20].
Solutions of PEG_{6000} with increasing concentrations were used to induce the various levels of osmotic stresses tested. The values of the hydrous potential tested are 0, 5, 25, 50, 100 and 200 g/l.

2.3. Statistical analyzes

The results are subjected to the analysis of the variance with only one factor, and the averages are compared by the test of Tukey with the threshold of 5% using the software Minitab16.

3. Results

3.1. Germination in condition of saline stress

3.1.1. Influence saline stress on the rate of germination

The examination of figure 1 illustrating the evolution of the rates of germination according to the increasing NaCl concentrations, watch which the increase in the saline stress actuates a reduction in the germinative capacity expressed compared to the witness. The concentration 5 mM allows a light improvement of germinative capacity which is of 72% compared to the witness (66%). The analysis of ANOVA shows a significant effect of NaCl on the germination of *C. h.* ($p \leq 0.05$).

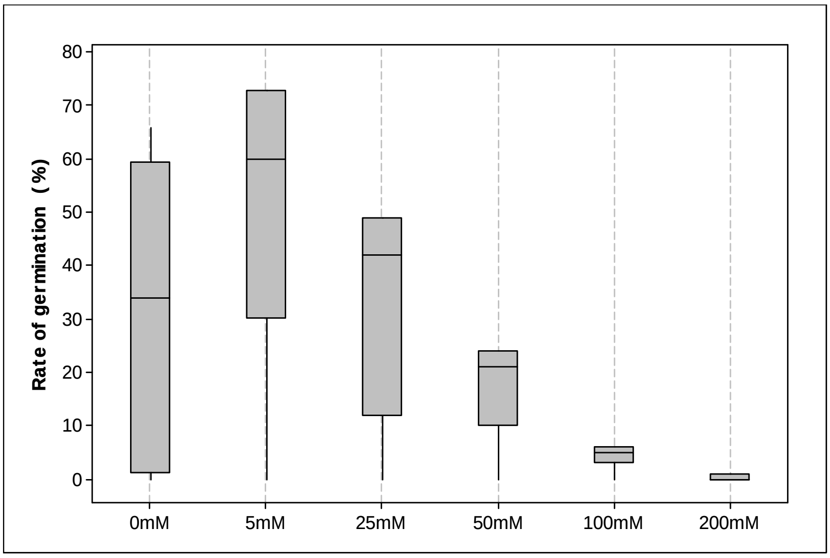

Figure 1. Germination rate of *Chamaerops humilis* under the effect of the saline treatment

3.1.2. Influence saline stress on the kinetics of germination

The kinetics of the germination of seeds under the effect of the increasing NaCl concentrations (Figure 2) described a form sigmoïdale including three phases. The analysis of this kinetics generally shows a first phase of latency, due to the imbibition of seeds, a second exponential phase where one witnesses an acceleration of germination. At the witness, the phase of latency lasts 14 days; the exponential phase of germination lasts 53 days, before reaching the stationary phase where germination stops after a maximum of germination. As the rate of salinity reaches 25, 50, 100 and 200 mM, the shape of this curve is modified in the direction of a stretching, resulting in a delay and a deceleration the speed of germination. However for 5 mM of NaCl, the latency time and the exponential phase are improved respectively to 10 and 44 days.

3.2. Germination in hydrous condition of stress

3.2.1. Influence hydrous stress on the rate of germination

The results concerning the germinative behavior of *C. h.* in terms of germinative capacity under the effect of the various concentrations of PEG appear on figure 2. The figure 3 shows that the germinative capacity of seeds of *Chamaerops* is affected considerably by the hydrous stress. Indeed, more the concentration of the medium in PEG increases more the germinative power decreases. The rates of germination obtained vary between 66% for the witness and 1% for the medium more concentrated in PEG (200 g/l). Thus the analysis of variance (ANOVA) shows a highly significant effect of hydrous stress on germination ($p \leq 0.05$).

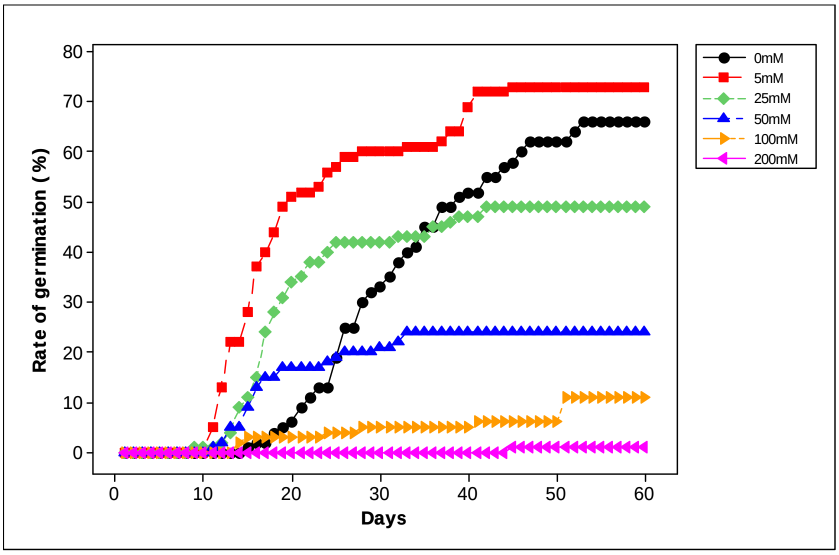

Figure 2. Germination kinetics of *Chamaerops humilis* under the effect of the saline treatment

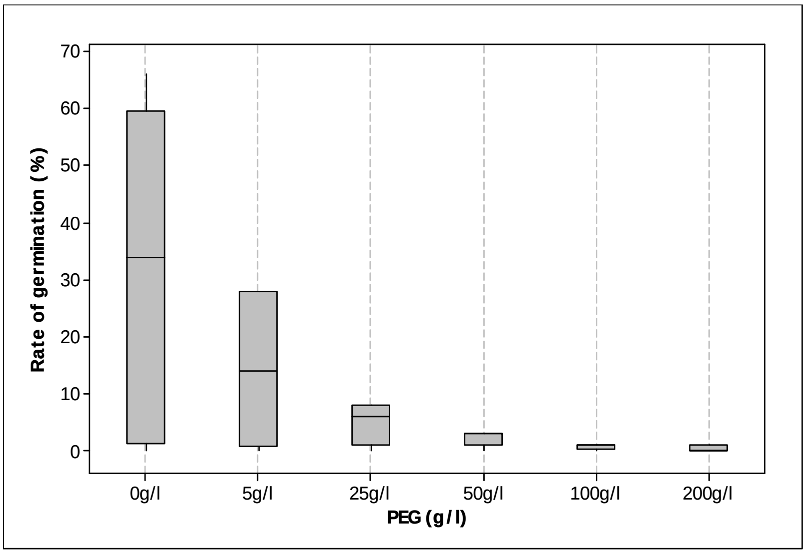

Figure 3. Germination rate of *Chamaerops humilis* under the effect of the osmotic treatment

3.2.2. Influence hydrous stress on the kinetics of germination

The kinetics of germination in conditions of osmotic stress is presented by figure 4, it reflects the sensitivity of the species to the hydrous stress on pilot medium, the curves of kinetics of germination post three phases: latency, acceleration exponentially and finally stage corresponding to a stop of germination after having reached the maximum germinative capacity. The depressive effect of the hydrous deficit on the germination of *C. h.* appears during one or of the whole of these three phases, according to the degree of lowering of the hydrous potential. The effect results in a deceleration the speed of germination visible as of the 5g/l treatment and which is accentuated thereafter.

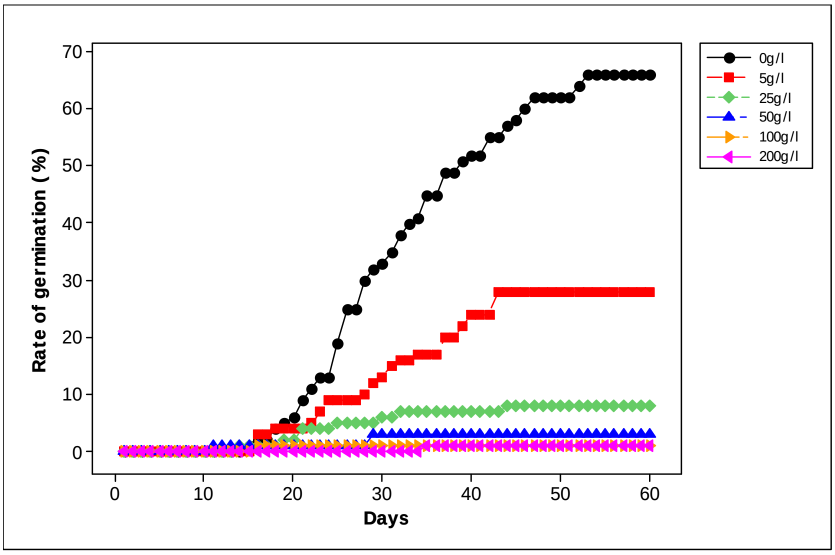

Figure 4. Germination kinetics of *Chamaerops humilis* under the effect of the osmotic treatment

4. Discussion

Studied *Chamaerops humilis* seeds have diverse behaviors towards the osmotic and salt treatment applied during the first phase of development. The results show significant differences in sensitivities of seeds examined against abiotic stresses. Concerning the behavior of the seeds of *C. h.* with regard to salinity, our study shows that NaCl slows down the speed of germination of *C. h.* and decreases their germinative capacity. These effects are all the more marked this salt concentration is high. The germination delay caused by increasing concentrations of the NaCl medium may result from a fix of hydration of seeds in consequence of a high osmotic potential and can be explained by the time necessary with seed to set up mechanisms allowing him to adjust its osmotic pressure interns [21-22] One can notice a relation between the tolerance with salinity at the time of germination and the ecology of each species. In this direction, Neffati [23] announces that the knowledge of the tolerance of salinity at the time of germination is useful information, but nonsufficient to explain the distribution of the species and their development in the salted mediums. The results relating to the effect of the hydrous stress on germination show that the seeds of *C.h.* are fairly tolerant with the hydrous stress. The limiting value of the potential for which the near total of seeds does not germinate any more locates at 100g/l.

The more the osmotic pressure is raised, the more the rate of germination decreases. This study made it possible to note that this species is demanding out of water in germinative phase, but this necessarily does not mean that the tolerant species with the hydrous stress during germination are those which are adapted to the drought at the adult stage [24].

Indeed, although it represents one of the significant factors in the establishment of the species [25-26], the tolerance with the hydrous stress at the time of germination constitutes, according to the conditions which follow this first phase of the vegetative cycle, either an advantage or a disadvantage [27]. The search listings relating to the effect of the hydrous stress on germination show that it is difficult to connect the tolerance to the hydrous constraints, at the time of germination, the ecology of the species even [28]. This result, also noted by Grouzis [27] for certain Sahelian species, makes it possible to say that resistance to the hydrous deficit in germinative phase is not the criterion prevailing of the ecological distribution of tax. Ndour *et al.* [29] affirm that the aptitude to be germinated in conditions of hydrous or saline stress is not obligatorily representative of the ecology of the adult plant, thus joining Sharma [30].

5. Conclusion

The study of the effect of the saline and hydrous stress by the means of NaCl and PEG_{6000} on the germination of seeds *C. h.* highlighted an effect treatment (concentration of PEG and NaCl) highly significant on the rate of germination ($p \leq 0.05$). Germination in condition of saline stress reveals a good tolerance of the species to salinity since it succeeds in germinating in high NaCl concentrations (to 100 mM, the rate of germination is equal to 11%). In addition, the germinative behavior of the species in hydrous condition of stress shows that this species does not support much the drought at the stage of germination (accentuated inhibition of germination starting from 25g/l). However, it remains necessary to continue these studies at all the stages of development before coming to a conclusion about its tolerance with respect to the saline and hydrous stress. It finally tries to determine if the answer to the pressures applied at the stage of germination constitutes a reliable early indicator of the behavior of the adult plant.

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