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Effect of Chemical Scarification, Salinity and Preheating on Seed Germination of *Prosopis farcta* (Banks & Soland.) Macbr.

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Abstract: The effect of chemical scarification, salinity and preheating on the germination of *P. farcta* as a primary step for its propagation in the newly reclaimed lands in Egyptian desert, were studuied. Thermal pretreatment showed no germination without chemical scarification, similar to those of untreated seeds. Moderate salinity, 75 and 100 mM NaCl did not affect the final germination percent, while the high salinity levels (150 and 200 mM NaCl), decreased it by about 30% and 70%, respectively. Germination percentage and the vigour value were increased with increasing time exposure periods of sulphoric acid, it reached 100% after 15 min and 20 min exposure respectively. The present study confirm the ability of *P. farcta* to grow in salt affected soil but its seeds needs scarification.

Key words: *Prosopis* · germination · salinity · scarification · Egypt

INTRODUCTION

The genus *Prosopis* with about 44 species widespread in arid and semiarid regions, Asia, America and Africa [1]. *P. farcta*, an invasive weed, distributed from India to Iran and spread more to the Middle East and occurs in Cyprus, Turkey, Ukraine and along the north African coast as far as Algeria. It is recorded recently that it causes a problem in agriculture in Jordan [2]. On the other hand, species of *Prosopis* are merit candidates for erosion control, stabilizing shifting desert or coastal sand dunes, windbreaks and for shelter belts. Many *Prosopis* species have been included in afforestation programmes and agroforstry-silvopastoral system [3]. Villargra *et al.* [4] recorded that the gradual deterioration of *Prosopis* increase soil erosion, favors desertification processes and reduces ecosystem productivity. Egypt is perhaps the most arid country in North Africa, desert ecosystems covers almost all of Egypt and extends south to Sudan. The desert areas represent more than 97% of the total area [5, 6]. Only one species, *P. farcta* has been cited for the Egyptian flora [7]. Germination and seedling stages are the most critical periods in the life cycle of xerophytes [8, 9]. Salt concentration in soils is an important factor affecting germination [10, 11]. *P. farcta*, present in Beni Suef Governorate-Egypt (along road sides of arable land), characterized by rapidly spreading, due to its easy propagation and remarkable ability to withstand both adverse conditions that reduce the competitiveness of neighboring plants and heavy grazing. Because of the previous character, induced fires by farmers are common to overcome its spreading. So the effect of temperature on seed germination of the studied species will be helpful, to predict the effect of fire on seed germination. No data are available on the economic impact or control of *P. farcta* in Egypt and information on this species in general are very limited worldwide. Therefore, the aim of this work is to study the effect of scarification, salinity and preheating on *P. farcta* germination to understand population dynamics of the species and the management possibilities of it.

MTERIALS AND METHODS

Ripe pods of the leguminous plant *P. farcta* were collected from their natural habitats, Beni Suef Governorate, along road sides of arable land. The chemical and physical soil analysis at the root zone of *P. farcta* are shown in Table 1 [12]. Seeds were removed from pods and stored in opaque paper bags at room temperature. For the germinability tests, the seeds were sown in sterilized Petri dishes on a double layer of filter paper moistened with 5 ml of the treatment solution. Three replicates of 20 seeds were used in each treatment; germination was under conditions of natural light and room temperature (during August 2005). Seeds were

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considered to be germinated after the radicle emerged from the testa. Germination speed was also calculated. It is a very important parameterfrom the ecological point of view [13]. It may be calculatedby different ways, however, the Vigour Value (V) has been chosen for the present study.It can be calculated using the following formula [14]:

$$V= (a/1 + b/2 + c/3+d/4 +\ldots\ldots\ldots + x/n) \times 100/S$$

where; a, b, c….., respectively, represent the number of seeds which germinated after 1, 2, 3 days of imbibition, x is the number after n days and S is the total number of germinated seeds. The different treatments were done as follow:

- *Salinity treatment*: The treatment solutions for salinity test were distilled water (control), 75 mM, 100 mM, 150 mM and 200 mM NaCl.

- *Preheating treatment*: Seeds were heated to a range of temperature similar to those registered during wildfires in the upper layer of soil (0-5 cm), where the majority of seed banks are usually concentrated [15, 16], ranged between 50-150°C, with variable heat exposure periods depending on depth and fire intensity. In this study was decided to test the treatment temperatures of 90, 120 and 150°C for duration of 1, 5 and 10 min. The preheating was carried out on dry seeds spread on glass dishes in a muffle furnace and the temperatures were maintained stable within a range of±2°C.

- Scarification methods were applied as follow: (a)-*Chemical scarification*: Seeds were scarified by putting in sulphoric acid (98%) for 5, 10, 15 and 20 min, then washed by running water many times (b)-*Thermal*: seeds were dipped in boiling water until water reached room temperature. Analysis of variance of data was done on an IBM compatible computer programmed and the least significant differences between the mean value were calculated as recommended by Bailey [17].

RESULTS AND DISCUSSION

Results showed no germination in control treatment (without scarification), unlike the finding of El-Keblawy and Al-Rawai [18] for *P. juliflora*, they found a high germination percentage for seeds did not recive any pre-treatment. The studied species, *P. farcta* with hard seeds require external stimuli for promotion the seed- coat rupture as recommended by Vilela & Ravetta [3]. This physical dormancy of the studied species helps it in germination over years. Thermal scarification by boiling water slightly increased germination and vigour value (20 and 9.8%, respectively). Germination percentage and the vigour value were increased with increasing time exposure periods of sulphoric acid, it reached 100% after 15 min and 20 min exposure respectively (Table 2).

Table 1: Some Chemical (a) and physical (b) analysis of soil samples collected from the root zones of *P. farcta*

(a)

Na (mg kg^{-1})	363.40±12.30
K (mg kg^{-1})	1123.20±23.10
P (mg kg^{-1})	5.01±0.01
Zn (mg kg^{-1})	1.50±0.30
Mn (mg kg^{-1})	4.05±0.60
Fe (mg kg^{-1})	22.55±2.10
Cu (mg kg^{-1})	5.81±2.11
Ni (mg kg^{-1})	0.51±0.01
Mo (mg kg^{-1})	Traces
Ca	196.40±2.300
Mg (mg kg^{-1})	677.30±63.100
PH	7.91±3.220
E.C (mS cm^{-1})	0.65±0.010
Organic C%	1.82±0.310
$SO4^{-}$ %	0.022±0.001
Cl^{-} %	0.023±0.001
HCO_3^{-} %	0.061±0.001

(b)

Coarse sand %	Fine sand %	Silt %	Clay %	Soil texture
3.80±0.20	9.70±0.2	38.8±0.6	47.7±3.0	Clay

Table 2: Effect of chemical and thermal scarifications on the germination percent and vigour value of *P. farcta* (values are mean of five replicates±S.E.)

Scarification time (min.)	Germination %	Vigour value
0	zero	zero
5	40±2.0*	27±2.1
10	90±1.3	52±3.1
15	100±0.0	65±1.6
20	100±0.0	90±1.3
30	100±0.0	90±2.1
Boiling water	20±2.2	9.8±1.1
LSD 5%	20.311	10.041
1%	28.47	14.078

* Mean±SE

Table 3: Effect of salinity (NaCl), after scarification, on germination percent and vigour value of *P. farcta* (values are mean of five replicates±S.E.)

	Control (mM)					LSD (%)	
	0	75	100	150	200	5	1
Germination %	100±0.0	100±0.0	100±0.0	70±2.2	30±3.1	8.176	11.629
Vigour value	90±2.2	75±2.0	65±1.7	38±1.9	20±1.3	9.487	13.494

* Mean±S.E.

Table 4: Effect of temperature on the germination percent and vigour value of *P. farcta* (values are mean of five replicates±S.E.)

Temp. (°C)	90			120			150			LSD	
Exposure time (min)	1	5	10	1	5	10	1	5	10	5%	1%
Germination %	60±1.5*	100±0.0	zero	55±2.3	90±2.4	zero	60±2.3	zero	zero	30.392	41.632
Vigour value	70±1.4	115±1.5	zero	62±3.1	80±2.2	zero	60±1.6	zero	Zero	13.102	17.947

* Mean±S.E.

Germination percentages and vigour values of *P. fartca* were decreased with high salinity levels (150 and 200 mM NaCl), germination percentages were decreased by about 30 and 70%, respectively, while the vigoure values decreased by about 62 and 80%, respectively (Table 3). Moderate salinity, 75 and 100 mM NaCl did not affect the final germination percent but decreased the vigour value by about 25 and 35%, respectively. Thermal pretreatment showed no germination without chemical scarification, similar to those of untreated seeds (Table 4). The different effect of chemical scarification and thermal pretreatment on germination rates may explain as a result of the different effect of this scarification on seed coat structures in species with hard coat seeds. Thanos & Georghiou [19], considered the slow germination of softened seeds by heat as an obvious ecological advantage in the summer-dry and fire-porne Mediterranean climatic conditions. At the same time after chemical scarification there was a total absence of germination recorded during long exposure times (10 min. at all temperature levels and at 5 min at 150°C). This result can be discussed by the fatal effect on embryo, as has been suggested by Tarrega *et al.* [20] for *Cytisus scoporius* and *Genista florida*. According to Kigel [21], extreme fluctuations of diurnal superficial soil temperature occurring in arid environment can break the hardness of seminal coats and allow germination. In nature there are many mechanisms producing the crack of the tegumentary barrier in legumes, as temperature oscillation and the alternance of dry and wet periods [22], bacteria and other microorganism's action and the chemical scarification induced by the herbivore digestive system [23]. Tarrega *et al.* [19], recorded the importance factor generated by wild fires. It can be concluded that seeds of *P. fracta* must be scarified before establishment in the new reclaimed lands and excluded its establishment in saline habitats.

REFERENCES

1. Ortega Baes, P. and M.l. de Viana, Sühring, 2002. Germination in *Prosopis ferox* Seeds: Effects of Mechanical, Chemical and Biological Scarifications. Journal of Arid Environments, 48: 171-184.
2. Qasem, J.R., 2007. Chemical Control of *Prosopis farcta* (Banks and Sol.) Macbride in the Jordan Valley. Crop Protection, 26: 572-575.
3. Vilela, A.E. and D.A. Ravetta, 2001. The Effect of Seed Scarification and Soil-media on Germination, Growth, Storage and Survival of Seedling of Five Species of *Prosopis* L. (Mimosaceae). Journal of Arid Environments, 48: 171-184.
4. Villagra, P.E., R. Villalba and Boninsegra, 2005. Structure and Growth Rate of *Prosopis flexusa* Woodlands in Two Contrasting Environments of the Central Monte desert. Journal of Arid Environments, 60: 187-199.
5. Abdel-Ghaffar, A.S., 1989. Aspects of Microbial Activities and Dinitrogen Fixation in Egyptian Desert Soils. Arid Soil Research and Rehabilitation, 3:281-294.
6. Zahran, M.A. and A.J., Willis, 1992. The Vegetation of Egypt. Chapman and Hall, London.
7. Boulos, L., 1999. Flora of Egypt. Al Hadara Publishing, Cairo, Egypt.
8. Rathcke, B. and E. Lacey, 1985. Phenological Patterns of Terrestrial Plants. Annual Review of Ecology and Systematics, 16: 179-214.

9. Sosebee, R.E. and C. Wan, 1987. Plant EcophysiologyL a Case Study of Honey Mesquite. Contribution No T-9-502.Lubbock: College of Agriculturealk sciences, Texas Tech University, pp: 103-117.
10. Mayer, A.M. and A. Poljakoff-Mayber, 1982. The Germination of Seeds. Oxford: Pergamon Press, pp: 211.
11. Ungar, I.A., 1995. Seed Germination and Seed-Bank Ecology of Halophytes. In: Kigel, J. and G. Galili (Eds.), Seed Development and Germination. Marcel Dekker Inc., New York, pp: 599-629.
12. Al Sherif, E.A., 2002. Effect of some ecological factors on the distribution, growth and nitrogen fixation of wild herb legumes under the prevailing environmental conditions at Beni-Suef Governorate, Ph.D. Thesis, Cairo Univ., Egypt.
13. Thomson, A. J. and Y. A. El-Kassaby, 1993. Interpretation of Seed Germination Parameters. New Forests, 7: 123-132.
14. Bradbeer, J.W., 1988. Seed Dormancy and Germination. Chapman & hall, New York, pp: 146.
15. Bradstock, R.A. and T.D. Auld, 1995. Soil Temperature during Experimental Bushfires in Relation to Fire Intensity: Consequences for Legume Germination and Fire Management in South- Eastern Australia Journal of Applied Ecology, 92: 76-84.
16. Simpson, R.L., M.A. Leck and V.T Parker, 1989. Seed banks: General Concepts and Methodological Issues. In: Leck MA, Thomas VT & Simpson RL (Eds), Ecology of soil seed banks. Academic Press, San Diego, California.
17. Bailey, N.T.J., 1994. Statistical Methods in Biology. 3th Edition, Cambridge University Press, London.
18. El-Keblawy, A.and A. Al-Rawai, 2005. Effects of Salinity, Temperature and Light on Germination of Invasive *Prosopis juliflora* (Sw.) D.C. Journal of Arid Environments, 61: 555-565.
19. Thanos, C.A. and K. Georghiou, 1988. Ecophysiology of Life-Stimulated Seed Germination in *Cistus incanus* subsp. *Creticus* (L.) Heywood and *C. salvifolius* L. plant. Cell and Environment, 11: 841-849.
20. Tarrega, R., L. Calvo and L. Trabaud, 1992. Effect of High Temperature on Seed Germination of Two Woody Leguminoseae. Vegetatio, 102: 139-396.
21. Kiegel, J., 1995. Seed Germination in Arid and Semiarid Regions. In Kiegel & galili G. (Eds.). Seed Development and Germination. New York: Marcel Dekker. New York, pp: 645-699.
22. Roslton, M.P., 1978. Water Impermeable Seed Dormancy. Botanical Reviws, 44: 365-396.
23. Pereiras, J., M.A. Puentes and M. Casal, 1985. Effecto de las Altas Temperatures sobre la Germinacion de las Semillas del tajo (*Ulex europeaus* L.). Studia Oecologica, 6: 125-133.