Influence of Pre-sowing Seed Treatments on Germination Properties and Early Seedling Growth of *Acacia cyanophylla*.

Ibrahim A. Eshkab, Mahmood B. Shanta, Hisham N. El waer.

Abstract— Priming is a technique through which germination properties and early growth of many crops can be improved. However, information on the response of tree and shrub seeds to priming is limited. Therefore, this study was carried out to evaluate the effects of different priming treatments; untreated seeds (control), hydropriming (soaked in distilled water), halopriming with 10 mmole $CaCl_2$, NaCl or KCl on germination capacity, germination rate and early seedling growth of *Acacia cyanophylla*. These five treatments were laid out in completely randomized design (CRD) replicated four times. Compared with unprimed seeds, all priming treatments significantly improved germination rate and dry weight of seedlings, whereas germination percentage remained unaffected. However, hydropriming achieved the highest germination rate and total dry weight biomass. This study shows that hydropriming is an effective, pre-sowing seed treatment for maintaining high germinability, improving germination rate and seedling growth of the studied species. Therefore, hydropriming treatment can be adopted by nursery and direct seeding operations to enhance the efficiency of afforestation programs of *Acacia cyanophylla* trees.

Keywords— priming, seed germination, seedling growth, *Acacia cyanophylla*

I. INTRODUCTION

THE multipurpose species *Acacia cyanophylla* is in the family Leguminosae (Mimosaceae) and is indigenous to Australia. Owing to its favourable characteristics including fast growth, its ability to tolerate drought and salinity [28], and to grow on marginal lands, and its great biomass productivity, *A. cyanophylla* has been introduced to North Africa [11], including Libya where a large scale plantation programme has been established both to conserve soils [13] and to ensure fodder availability particularly in dry seasons [10]. It has been estimated that 80,000 ha has been planted with *Acacia* species, the majority of which is *A. cyanophylla* [13]. In North Africa, it is also planted for firewood production as well as for ecological purposes such as sand dune fixation and windbreaks [28], for combating desertification [2], it is also used as an ornamental and for environmental protection [31]. The species is commonly nurtured in nurseries and transplanted in the field at the initiation of the rainy season. However, direct seeding may be successful in humid environments.

Due to harsh local environmental conditions, the survivability and establishment percentage of many species including *A. cyanophylla* are very low. Thus, to ensure successful plantation under such unfavourable gradients it is very important to use high seed and seedlings vigour. One simple and cheap approach can be used to achieve this goal is seed invigoration known as seed priming [5]- [16]- [17].

Priming is one of seed treatment that has been proved to be an effective technique in enhancing seed germination, germination rate, uniformity and seedlings growth under both normal [18]- [47]- [37] and stress conditions [42]- [5]- [43]- [1]. Priming is a controlled hydration treatment at low water potential through which pre-germinative metabolism are proceed, but radicle emergence is prevented [7]- [4]. In the last two decades, the technique has been widely used to investigate the beneficial effects of seed priming on seed vigor for many plants either under normal or stress conditions [3]. There are several priming methods used and classification relies on the type of priming agents. These include hydropriming, halopriming, hardening and osmopriming [17], hormone priming, solid matrix, humidification and stratification and thermal shock [25]- [32].The first four approaches are the most common for the purposes of priming [12].

It has been reported that seed priming results in the enhancement of seed germination of plants such as mungbean (*Vigna radiata*) [33], common alder (*Anlus glutinosa*) [4] and several acacia species [29]- [35]- [36]- [9], (*Ziziphus spina-christi*) [45], okra (*Abelmoschus esculentus*) [5],enhancement of emergence rate of armada pine (*Pinus armadii*) [46], Japanese cedar (*Cryptomeria japonica*) [26], Norway spruce (*Picea abies*), silver birch (*Betula pendula*), beech (*Fagus sylvatica*) and shore pine (*Pinus contorta*) [40], common alder (*Alnus glutinosa*) and downy brich (*Betula pubescens*) [4] maize (*Zea mays*) and chickpea (*Cicer arietinum*) [19]- [20], mungbean [33], wheat (*Triticum aestivum*) [27], cowpea (*Vigna unguiculata*) [41], increased uniformity and seedling establishment of red oak (*Quercus rubra*) [44], marica (*Mimosa bimucronata*) [8], lodgepole pine (*Pinus contorta*) and white spruce (*Picea glauca*) [22], and increased output of barley (*Hordeum vulgare*) [34], maize and chickpea [19]- [21] mungbean [33], and seedlings quality of christimas tress (*Pinus brutia*) [24], *Acacia nilotica* [30].

Ibrahim A. Eshkab (Corresponding author) is with the Range and Forestry (Natural Resources) department, Faculty of Agriculture, University of Tripoli, Tripoli – Libya. Phone: +218-928010223 E-mail: iaeshkab@yahoo.com.

Mahmood, B. Shanta is also with the Range and Forestry (Natural Resources) department, Faculty of Agriculture, University of Tripoli, Tripoli – Libya. E-mail: shantta@yahoo.com.

Hesham, N. Alwaer is also with the Range and Forestry (Natural Resources) department, Faculty of Agriculture, University of Tripoli, Tripoli – Libya. E-mail:hisham98m@yahoo.com.

This research is designed to evaluate the response of *A. cyanophylla* seeds to pre-sowing seed treatments.

II. Material and Methods

Prior to priming treatments, seeds of *A. cyanophylla* were mechanically scarified to overcome physical dormancy. Sufficient numbers of seeds were then treated with different priming agents. For halopriming, 100 seeds were treated with 10 mmole of NaCl, $CaCl_2$ or KCl solutions. For hydropriming, 100 seeds were treated with distilled water (DW). Soaking seeds in priming media was conducted at room temperature for 16h. Pre-germination, haloprimed seeds were washed with distilled water for five minutes to eliminate traces of salts. Later, primed seeds were left to dry in air between two filter papers. Primed and non-primed seeds were placed in 9 cm petri dishes on two layers of Whatman No. 1 filter papers and irrigated with 10 ml of distilled water. The Petri dishes were placed in a germinator at 25 °C and 16:8 h day / night regime. The experiment was arranged in a completely randomized design with four replications and 25 seeds per replicate. Seed germination was recorded daily up to day 14 after the commencement of the experiment. A seed was considered germinated when the radicle length was about 2 mm. At the end of the experiment, the dry weights of the obtained seedlings were measured. Significance of difference between treatments was tested by ANOVA and means separated by Tukey's Honestly Significant Difference Test (HSD).

III. Results and discussion

Results for germination capacity were found to be not significant at ($P \leq 0.05$) for all treatments (Fig. 1). Although all priming treatments improved germination capacity up to 99%, no significant effects could be attributed to the high germination percentage of 94% recorded in un-primed seeds.

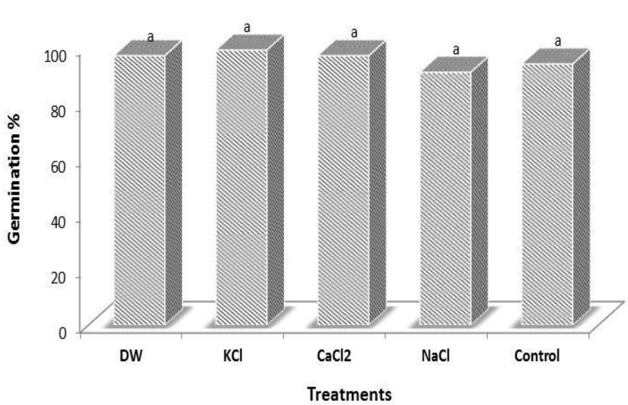

Fig. 1 The Effect of Priming Treatments on The Germination Percentage of *A. cyanophylla* Seeds. Means not followed by the same letter differ significantly at ($P \leq 0.05$).

Thus, the influence of priming treatments on germinability can be described as a positively unbiased effect. The result is in agreement with [6], who reported that the germination percentage of *Acacia senegal* primed with $CaCl_2$ was similar to the control. Similar results have been reported by [5]- [18]. No significant effects of $CaCl_2$, KCl and hydropriming on the germination of *A. tortilis* and *A. coriacea* seeds [35]. In contrast, enhancement of seed germination of common alder (*Anlus glutinosa*) [4] and several acacia species [29]- [35]- [36]- [9], ziziphus (*Ziziphus spina-christi*) [45] has been found.

Seed germination rate was significantly influenced by seed priming treatments at ($P \leq 0.05$) (Fig.2). Generally, all priming medium increased the germination rate compared with untreated control. However, there were significant differences between treatments and the highest was observed in hydroprimed seeds. Similar effects of hydropriming on the germination rate has been observed by [35] with *Acacia tortilis* and *A. coriacea*, [45] with *Ziziphus spina*-christi and [41] with *Vigna unguiculata*. Halopriming has also been found effective in enhancing the germination rate of *Acacia senegal* [6] *A. tortilis* and *A. coriacea* [35], *Triticum aestivum* [5] or *Vigna sinensis* [12], and *Sorghum bicolor* [39]. Completion of pre-germination metabolic activities during seed priming, making the seed ready for soon germination after planting compared with unprimed seeds [38] or [12]. Therefore, the rapid germination rate that was observed in primed seeds is probably due to faster water uptake and earlier initiation of metabolism processes.

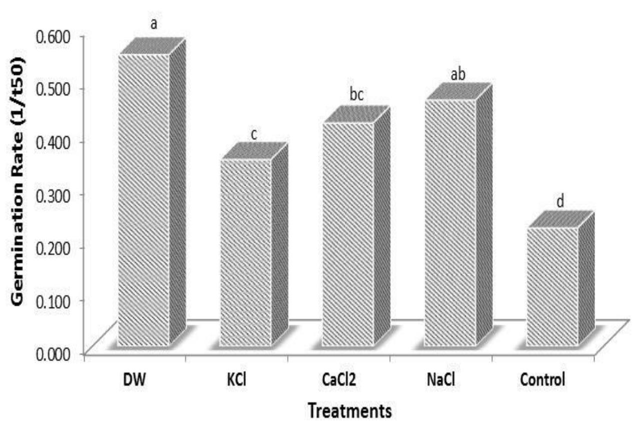

Fig. 2 The Effect of Priming Treatments on The Germination Rate of *A. cyanophylla* Seeds. Means not followed by the same letter differ significantly at ($P \leq 0.05$).

Analysis of variance also indicated that seedlings dry weight was significantly influenced by seed priming treatments (Fig.3). Generally, all priming medium increased the seedlings dry weight compared with untreated control. However, there were significant differences between treatments. The seedlings dry weight analysis of variance allowed priming treatments to be ranked: distilled water > KCl > CaCl2 > NaCl > un-primed seedlings.

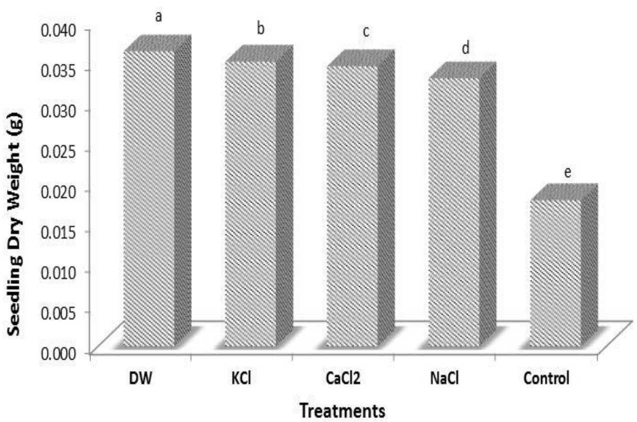

Fig. 3 The Effect of Priming Treatments on The Dry Weight of *A. cyanophylla*Seedlings. Means not followed by the same letter differ significantly at ($P \leq 0.05$).

These results are in agreement with [41] on (*Vugna unguiculata*), [12] on (*Vigna sinensis*), [23] on (*Oryza sativa*). The superior performance of primed seedlings over un-primed control could be attributed to earlier germination induced by priming [45], or due to the enhancement of cell division within the apical meristem of seedling roots, which cause an increase in plant growth [39].

V. Conclusion

The present study suggests that priming treatments particularly hydropriming can improve germination rate and seedling growth. Furthermore, the treatments are economical, environmentally friendly and easily applicable by nursery workers and poor farmers and also may encourage direct seeding where applicable.

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