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***Corresponding author**
Rukhsar Shaheen
E-mail
doriskalele@gmail.com

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Evaluation of Seed Germination of *Sorghum bicolor* Grown After Priming with Leaf Extract and Milky Sap Exudate of *Calotropis procera*

Rukhsar Shaheen*, Ali Razzaq

Department of Botany, University of Okara, Multan Road, Renala Khurd, Okara, Punjab, Pakistan

Abstract

A pot experiment was conducted to investigate the effect of priming with the extract of plant *Calotropis procera* on seed germination of *Sorghum bicolor*. The seeds of *Sorghum bicolor* were primed with different concentrations of *Calotropis procera* leaf extract and milky sap exudate for five days at different time intervals. In total, there were five groups of days and nine seed priming treatments. The result showed that maximum seeds were germinated on day 4 in all treatments, but it was not significantly different from day 2, 3, and day 5. Whereas the highest germination of seeds was noted in two treatments, 24 hours priming with 100% boiled leaves extract (T3) and 24 hours priming with 100% milky exudate (T4), irrespective of priming days, except one day. These results showed that both milky exudate and boiled leaf extract have a positive effect on seed germination of *Sorghum bicolor*; therefore, in the future, both types of extracts of *Calotropis procera* should be considered important for priming the seeds of different plants to improve seed germination.

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Introduction

Seed priming is a pre-sowing treatment, in which, seeds are soaked in an osmotic solution that permits seeds to absorb water and go through the first stages of germination [1]. Seed priming enhances vigor for fast and strong plant development, enhances yield potential, enables seeds to germinate and emerge even under adverse agro-climatic conditions [2]. Recently, there has been an increased interest in seed soaking to improve establishment [3]. Though it is an old concept, significant progress has been made in developing seed soaking into a practical technology for use by small-holder farmers called on-farm seed priming [4]. It is an accepted fact that priming improves germination, reduces seedling emergence time and improves stand establishment [5]. *Sorghum bicolor*, commonly called sorghum plant, is an annual and short-term perennial grass species belonging to the family *poaceae*. It is also known as great millet, durra, jowar, or milo and is cultivated for its gains. Sorghum is the world's fifth-most important cereal crop after rice, wheat, maize, and barley. It is believed to have originated in Africa, particularly in Ethiopia and surrounding countries [6]. It is high in carbohydrates, protein, and fat, and contains calcium, iron and niacin. Dezfuli et al. [7] evaluated the influence of seed priming techniques on germination and early growth of plants and reported that priming techniques positively affect seed germination and early growth. Many recent researchers also suggested that seed priming of crop seeds might be a useful way for better germination, seedling growth, establishment, and yield [8].

In the family Apocynaceae, *Calotropis procera* is a species of flowering plants. A toxic milky sap is obtained from its green fruits that are extremely bitter. The reason for its toxicity is steroidal components that are the cause of its toxicity. Allelopathy is a natural phenomenon in which various organisms affect the functioning of other organisms by releasing secondary metabolites [9]. Some plants release chemical compounds from different parts into their environment and these compounds are often referred to as allelochemicals [10]. These are secondary metabolites secreted in very low amounts by plants but play a very important role in plant defense against pathogens or other abiotic factors [11]. These allelochemicals are alkaloids, phenolics, terpenoids, hydroxamic acids, salicylates, etc. In the present study, the leaf extract and milky sap exudate of medicinal plant *Calotropis procera*, locally called Aak, were used for seed priming and its effect on seed germination of *Sorghum bicolor* was evaluated.

Materials and Methods

Site of experiment

The experiment was conducted in the Environmental and Bio-Tech Laboratory of University of Okara, Renala Khurd, Punjab, Pakistan located at coordinates of 30°52'04.19″N and 73°34'08.45″E.

Selection of plant for seed priming

The plant *Sorghum bicolor* was selected to evaluate the effect of seed priming, and its seeds were bought from the market.

Preparation of extract and exudate

The plant *Calotropis procera* was selected to obtain leaf extract and milky sap exudate as a priming agent. The plants were chosen from the sides of the road and canal of Depalpur, Pakistan. Fresh leaves and plant tips of *Calotropis procera* were collected for the plant extract and exudate collection. To collect the milky sap exudate, tips of *Calotropis procera* plant were pressed hard by hand and the white sap exudate was collected in a washed bottle, which served as the stock solution to prepare different dilutions (10%, 50%, 100%). To prepare leaf extract, leaves of *Calotropis procera* were boiled in water for one hour and then filtered with cheesecloth to get water extract. The seeds were primed with 100% of leaf extract for 6, 12 and 24 hours.

Treatments

Following treatments were organized for this experiment:

T0 = seeds without priming

T1 = priming for 6 hours with 100% of boiled leaves extract

T2 = priming for 12 hours with 100% of boiled leaves extract

T3 = priming for 24 hours with 100% of boiled leaves extract

T4= priming for 24 hours with 100% milky sap exudate

T5= priming for 24 hours with 50% milky sap exudate

Table 1 Average seed germination of *Sorghum bicolor* primed with leaf extract and milky sap exudate of *Calotropis procera*.

Treatments	Time (days)					
	1	2	3	4	5	mean
T0	ND	3.00^{b}	3.33^{cd}	3.33^{cd}	3.30^{cd}	3.67^{D}
T1	1.67^{f}	4.67^{b}	4.67^{b}	4.67^{b}	4.67^{b}	4.07^{C}
T2	2.33^{e}	4.67^{b}	4.67^{b}	4.67^{b}	4.67^{b}	4.20^{B}
T3	4.00^{c}	5.00^{a}	5.00^{a}	5.00^{a}	5.00^{a}	4.80^{A}
T4	2.67^{d}	5.00^{a}	5.00^{a}	5.00^{a}	5.00^{a}	4.53^{AB}
T5	ND	5.00^{a}	5.00^{a}	5.00^{a}	5.00^{a}	4.00^{C}
T6	0.67^{g}	4.67^{b}	4.67^{b}	4.67^{b}	4.67^{b}	3.87^{CD}
T7	1.50^{f}	2.67^{d}	3.00^{d}	3.00^{d}	3.00^{d}	2.63^{E}
T8	0.33^{h}	2.67^{d}	2.67^{d}	2.67^{d}	2.67^{d}	2.20^{F}
T9	ND	1.67^{f}	1.67^{f}	2.00^{de}	2.00^{de}	1.50^{G}
mean	1.31^{B}	3.90^{A}	3.97^{A}	4.00^{A}	3.99^{A}	

ND = no data found; data are mean of three replicates; small letters show differences in overall data of all treatments and days, while capital English letters show differences in the means of treatments and time points, separately.

T6= priming for 24 hours with 10% milky sap exudate

T7= priming with tap water for 24 hours

T8= priming with tap water for 12 hours

T9= priming with tap water for 6 hours

Preparation of pots and data collection

The medium for plant growth was prepared by mixing 70% clay and 30% sand thoroughly to get a homogeneous mixture and used to fill the ½ liter plastic pots. After priming, five seeds were sown in each pot at an equal distance from each other. Each treatment has three replicates. Each pot was irrigated after every 24 hours with tap water regularly. The number of seeds germinated up to five days were counted and the mean values were presented.

Results and Discussions

The seed priming initiates the biochemical processes in seeds at the initial stage of germination by managing the temperature and moisture contents and bringing seeds closer to the germination stage [1]. In addition, during priming, seeds reach equally to the germination stage and uniform germination is possible. The use of water solutions containing salt, plant hormones or other chemicals is a common priming method. In addition, plant materials like plant extracts are also used as priming agents to improve the priming of seeds [12]. In this study, we also determined the effect of leaf extract and milky sap exude of a roadside plant *Calotropis procera* on the germination of seeds. The results of seed germination of *Sorghum bicolor* in different treatments are given in Table 1. The result showed that maximum seeds were germinated at day 4 in all treatments, but not significantly different from day 2, 3 and day 5. Whereas highest germination of seeds was noted in two treatments, 24 hours priming with 100% boiled leaves extract (T3) and 24 hours priming with 100% milky exudates (T4), irrespective of priming days, except one day. The extracts and parts of plant *Calotropis procera* have been reported beneficial as nematocidal, molluscidal and insecticidal agents, building material, adsorbent, animal feed, fuel, etc [13]. Here, the results showed that priming with the leaf extract and milky exudate could also be beneficial to improve seed germination of *Sorghum bicolor*, which would provide a good beginning for the rest of the plant growth stages. We recommend that leaf extract and milky exudate of plant *Calotropis procera* should also be tested for the seed priming of other important plant species.

Conflict of Interest

The authors declare that they have no conflict of interest

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