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SEED GERMINATION IN *BIXA ORELLANA* L.

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Abstract: The present study embodies data on phonology of flowering, fruiting and other seed characteristics of *Bixa orellana* L. Various methods such as chemical scarification, mechanical scarification with sand paper, temperature and hot water treatment were used to improve the seed germination. Out of these, scarification with concentrated sulphuric acid (H_2SO_4) for 15 minutes resulted in 93% germination. Soil depth of 2 cm loamy soil and alternate day watering were found to be very effective in the germination of the seeds.

Key words: Dormancy, *Bixa orellana* L., seed germination

INTRODUCTION

Bixa orellana L. (commercially known as "Annato") is a native of tropical America and West Indies. It is now widely grown throughout the tropics and becoming naturalized in some areas (Purseglove, 1984). The plant is a shrub or small tree that attains the height of about 5-6 m in 3-4 years. It is most attractive when the pink, rose-like flowers are in bloom. The heart-shaped capsule is about 3-5 cm long, normally in clusters of between 25-30. Such clusters (250-300 in number) can be observed on a mature shrub or small tree usually covered with soft spines, housing the thin pulpy vermilion skin seeds. The seeds vary in number from 30 to 50 per capsule.

Several attempts have been made to classify the phenomenon of dormancy in seeds; however, a general useful classification has been reported by Crocker (1906) and has served well both for research into dormancy characteristics of many kind of seeds and for the discovery of dormancy breaking techniques for use in agriculture and forestry.

Germination studies are fundamental to any plant multiplication scheme particularly where, as in this case, the plant does not grow by cutting. Presently, not much is known on ways of stimulating germination in this species. This study was carried out with a view to provide information on the effect of different scarification methods on the seed germination of *B. orellana* and to investigate the soil and water conditions in which *B. orellana* seeds would germinate best.

MATERIALS AND METHODS

Seeds of *Bixa orellana* used for this study were obtained from the Air Force base compound, Ikeja, Lagos State, Nigeria. Ripe capsules were collected and the seeds were removed and kept in air-tight, screw-cap glass vials. One hundred randomly selected capsules were opened and the seed distribution per capsule was observed. Seed shape, volume, percentage moisture content and viability were determined after Pandey *et al.* (1968).

Seeds used for the germination studies were surface sterilized with 0.1% mercuric chloride for 1 min and then rinsed with distilled water. Different methods used to improve germination were emoployed after Gill and Bamidele (1981) and Gill *et al.* (1981, 1982, 1986, 1990).

Each treatment was represented by five replicates of twenty seeds each placed on moist filter paper (Whatman No.1) in petridishes. Germination of untreated seeds in a petridish (at room temperature 30± 3°C) formed the control for all treatment. Studies were carried out under continuous light (using fluorescent lamps at bench level) and one set in continuous darkness.

Effect of soil depth on seed germination

A set of twenty seeds in three replicates, were sown at various depths of 2, 4, 6 and 10 cm respectively in plastic containers filled with garden soil. Surface sowing was carried out by broadcasting the seeds on the surface of the soil in one set of the containers. Observations were recorded until 50% of seeds had germinated in each treatment.

Effect of soil type on germination

This was carried out by sowing seeds (twenty in three replicates) in plastic containers filled with four different soil types viz., garden soil, white sand, clayey soil and loamy soil. The pH of the different soil types was determined, using Phillips PW 9418 pH meter, according to Chapman (1976) and percentage germination recorded after eight weeks.

Effect of water level on seed germination

In order to determine the optimum water requirement for the germination of B. *ordlana*, seeds were sown in plastic containers containing garden soil and watered daily, alternate days, weekly, fortnightly with 300 ml of distilled water. The last set of the containers was kept waterlogged during the experimental period. Percentage germination of seeds for a period of eight weeks was recorded.

Effect of seed own extract on germination

One hundred seeds were milled, shaken in distilled water (250 ml) and filtered. The filtrate was used to moisten the filter paper on which the seeds were put for germination while distilled water was used on seeds that served as control.

RESULTS AND DISCUSSION

Table 1 summarizes the phenological data which include seed size, shape, volume, weight and percentage moisture contents. Results of various treatments of

Table 1. Phenological data of *Bixa orellana*

Flowering period	:	June to August
Fruiting period	:	August to Nov/Feb
Capsule length, cm	:	3.98±0.38*
No. of seeds/capsule	:	48.08±3.13*
Seed colour	:	Bright red
Seed length, mm	:	4.26±0.43*
Seed weight, g	:	0.022±0.002*
Seed volume, cm^3	:	0.02
Seed moisture, %	:	5.32
Seed shape	:	Obovoid

*Standard error

B. *ordlana* seeds are summarized in Table 2. The scarification of seeds with conc. H2SO4 for 15 minutes resulted in 93% and 80% germination under continuous light and dark conditions, respectively. Gill and Bamidele (1981) also observed higher percentage germination in the seed of *Dialium guineense* and *Parkia clappertoniana* when the seeds were treated with conc. H_2SO_4 for 10 min. The rate and percentage germination (80%) were faster than the control (23%) when the seeds were scarified with sand paper. Wounded seeds show increased dehydrogenase activity especially at the site of injury. By initiating these redox reactions, the whole metabolism of the seed may be invoked and germination results (Hay, 1962). Such finding provides circumstantial evidence that the control mechanism of germination is based on respiration.

Aqueous seed extracts had inhibitory effect on the percentage germination of seed, as only 13% germination was recorded as against 27% in the control (Fig.1). These values showed a significant difference at 5% level (LSD multiple range test).

Seeds treated with hot water for 4 min at 60°C resulted in 67% germination

Table 2. Percentage germination under various treatments

Treatments	Germination %	
	Light condition	Dark condition
Chemical treatments		
H_2SO_4 (98%), 15 min	93±2.13	8010.46
" 5 min	53±0.34	5013.21
" 2 min	43±0.62	40+2.16
HNO_3 (98%),15 min	67±1.36	58+0.18
" 5 min	2710.84	2710.11
" 2 min	4013.84	4210.33
HCl (36%), 15min	60±2.82	55+0.56
" 5 min	60±0.36	53±4.10
" 2 min	4311.66	4013.16
$HClO_4$ (60%), 15 min	5010.11	4713.34
" 5 min	3712.23	3011.68
" 2 min	30± 2.16	2612.19
Mechanical scarification with sand paper, 8 min	80+3.41	80+0.81
" 6 min	50±4.18	4311.28
" 2 min	3313.16	3011.62
Control	23±1.23	2310.41
Hot water treatment		
for 1 min at		
60°C	4010.36	30±1.34
100°C	0	0
for 4 min at		
60°C	6712.41	5312.23
100°C	0	0
Control	23±0.13	20±2.18
Temperature treatment		
for 1 hour at		
50°C	7310.16	70+0.02
80°C	13±0.12	10+2.13
100°C	0	0
for 6 hours at		
50°C	77+2.22	73+0.31
80°C	10+0.21	7+0.30
100°C	0	0
for 12 hours at		
50°c	23+0.10	10+0.02
80°C	0	0
100°C	0	0
Control	2710.04	23±0.15

Table 3. Effect of soil depth on seed germination

Depth of soil	Days to 50% germination
Surface sowing	No germination
2cm	12
4cm	20
6cm	No germination
8cm	No germination
10 cm	No germination

under continuous dark condition. When given boiling water treatment at 100°C, seeds did not germinate. This could be due to loss of viabiliy as a result of scarcity of oxygen, since water at high temperature retains less gaseous content (Gill *ct al.* 1981).

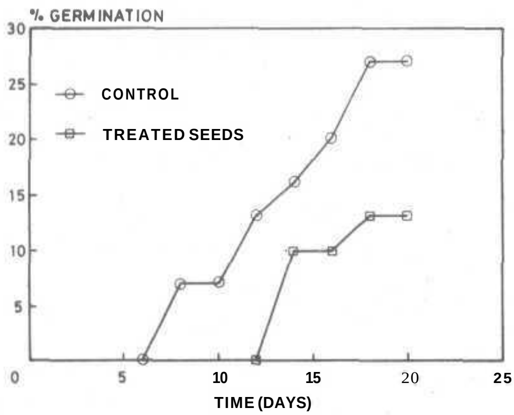

Fig. 1 Percentage germination of *Bixa orellana* seed treated with seed own extract

Temperature played an important role in determining the final level and rate of germination. High percentage germination was recorded in seeds incubated at 50°C for 6 hours (77%) under light condition and (73%) under dark condition. Seeds incubated at high temperature i.e., 80°C and 100°C, resulted in loss of viability of the seeds. The effects became more pronounced with increasing duration of treatment. Mott and Mckeon (1979) and Mayer and Poljakoff-Mayber (1963) suggested that the precise sensitivity of seeds to temperature is variable from species to species. Considering the effectiveness of temperature, the duration of treatment is important due to its close relationship with the denaturation of proteins and the consequent loss of viability.

In all the treatments percentage germination was highest in experiments under continuous light than continuous dark condition. Chen (1968) believes that light influences the ability of the radicle to overcome mechanical resistance by the seed coat.

Table 4. Percentage germination of seeds sown in different soil types

Soil type	pH	Germination%
Loam	6.9	60±0.48
Sea sand	6.8	37±3.16
Garden soil	7.0	43±1.34
Clayey soil	6.2	23±1.90

Table 5. Percentage germination of seeds treated with different water level

Water level	Germination %
Waterlogged	No germination
Daily	50±3.12
Alternate days	70±3.60
Weekly	53±1.43
Fortnightly	17+4.02

The highest percentage germination (60%) was obtained in loamy soil with pH 6.9 and least (23%) in the clayey soil (Table 4). This can be due to the fact that loamy soil retains more moisture and is well aerated, while the clayey soil is usually waterlogged, thus retarding germination by excluding air.

A depth of *2* cm was most suitable for germination of B. *orellana* seeds while sowing at 4 cm depth resulted in low percentage germination and under other depths there was no germination (Table 3). However, Shibayama (1982) and Okusanya (1978) reported faster germination at 1 cm depth for *Mimosa pigra* and *Luffa aegyptiaca* respectively.

The highest percentage (70%) of seed germination was obtained when seed were irrigated on alternate days and seeds did not germinate under waterlogged condition (Table 5). Similar results were obtained by Shibayama (1982) for *Mimosa pigra.*

From the present study, it is concluded that the seeds of B. *ordlana* cannot grow in areas where the soil is waterlogged throughout the year. The seeds germinate better in loamy soil than clayey soil. Chemical treatment with conc. H_2SO_4 and the presence of light stimulate good germination in B. *ordlana* seeds.

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