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Overcoming Seed Coat Dormancy of Caesalpinia Benthamianus

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Abstract
Caesalpinia benthamianus(Baill.,)Herendeen and Zarucchi Synonym *Mezoneuron benthamiana* Baill.,commonly known as Tiger Claw plant is a shrub belonging to the natural Order Fabales,Family Fabaceae(Leguminosae)and Sub-Family Caesalpinoideae.Economically important for traditional medicine purposes,useful as chewing stick and as a boundary fence against grazing animals because of its thorny nature.*Caesalpinia benthamianus* exhibits seed coat dormancy.Seeds were sown in white plastic buckets filled with loose and well drained river sand at 2 x 2 cm spacing and at sowing depth of 3 cm.Bucket diameter was 22 cm and bucket depth from base to the bream was 24 cm.4 replications of 100 randomly picked seeds at 25 seeds per bucket was used for each treatment. Buckets were laid out in complete randomized design. Viable seeds determined by floatation method were subjected to pre-treatments using control, 98% Concentrated Sulphuric acid and physical abrasion for 4 minutes. Results shows that Physical scarification with 78% Seedling emergence and lowest Mean Emergence Time of 10 days was most efficient.Acid scarification gave 40% and Mean Emergence Time of 19 days.Control experiment gave 36% and Mean Emergence Time of 18 days.Thus 4 minutes Physical scarification treatment is highly recommended for the propagation of *Caesalpinia benthamianus* seeds.

Keywords: *Caesalpinia benthamianus*,Seed Pre-treatments,Seedling Emergence Percentage,Mean Emergence Time

Introduction
Caesalpinia benthamiana (Baill.)Herendeen and Zarucchi Synonym *Mezoneuron benthamianus* Baill.commonly called Tiger Claw is a shrubby plant belonging to the natural Order Fabales, Family Fabaceae and Sub-Family Caesalpinoideae.Economically important as chewing stick,for traditional medicine purposes and as boundary fence against grazing animals because of its thorny nature (Burkill,1995).
Etymologically,*Caesalpinia* Genus is named after the Italian Physician and naturalist Andrea Caesalpino(1519-1603) and the specific epithet *benthamianus* after George Bentham(1800-1884).The centre of origin of the plant is Africa. *Caesalpinia Linn.*, Genus consists of 100 tropical and sub-tropical, often hook climber species (Willis and Airyshaw, 1973).
Caesalpinia benthamiana plant is usually a woody climber with short re-curved prickles.Leaves bi-pinnate with alternate leaflets,elliptic and rounded at both ends,3-4cm long and 1.5-2.5 cm broad.Flowers yellow in simple or branched racemes,tomentellous,pedicel about 1 cm long.Petals 5, bright red in colouration,Stamens 10,free, filaments pilose.Pod –fruits indehiscentreflexed,flat and thin,linear-oblong, about 10 cm long and 2-2.5 cm broad,minutely puerulous,winged along one side.(Hutchinson and Dalziel, 1958)
A seed is a fertilized, ripened and mature ovary containing one or more ovules as in Gymnosperm and Angiosperm plants.A typical seed consist of three basic parts i) an embryo ii) a supply of nutrients for the embryo and (iii) a protective seed coat (testa).The seed has the capability to regenerate into a new Spermatophyta plant.
Seed longevity is the duration of seed viability. Seed viability can be defined as the abilty of the embryo is to be alive and develop into a Seedling under favourable environmental conditions. An embryo remains in a quiescent state i.e in physiologically in-active state in

dry seeds,but with imbibition or in-take of water,all the cells of the seed turn turgid, becomes physiologically active resuming sactive metabolism triggering cell growth and differentiation with polarized development into a plumule and radicle(Sen and Ghosh,1999).

Normally, seeds possess maximum germination potential during their physiological maturity and deterioration of seed quality occurs from their point of maturation onwards. The rate of seed deterioration increases due to mechanical injury at the time of harvesting and seed processing, higher moisture content in seeds and exposure of stored seeds to micro-organisms and insects also cause reduction of seed longevity and quality, while seed storage under low moisture content, cool temperature and low oxygen tension promotes seed longevity (Balasubramaniyan and Palaniappan, 2014).

Sen and Ghosh,1999 defined Seed Viability as a state of good health and natural robustness in seeds which upon planting permits rapid germination,survival and normal growth of the Seedlings.Seed Viability is defined as the degree to which a seed is metabolically active and capable of germinating under favourable conditions. Seed viability is at highest at the time of physiological maturity. Seeds with high moisture content deteriorates quickly because of energy expenditure and accumulation of breakdown processes by the degradation of mitochondria which permanently loses their ability of swelling and contraction due to the ageing of the mitochondria and as the age of the seed increases, the semi-permeable membrane of the cell organelles loses their selective permeability allowing metabolites to leach out with subsequent loss of seed viability (Balasubramaniyan and Palaniappan, 2014).

Seed vigour is defined as the condition of the seed that permits germination to proceed rapidly, allowing production of uniform Seedling stands (Http: www.). The vigour of seeds depends on the genome, history of the individual seed and the environment in which the seed is sown. Vigorous seeds produce seedlings of natural robustness with good health, disease free, physically sound, germinating quickly and producing rapidly developing seedlings (Balasubramaniyan and Palaniappan, 2014).

One of the most pertinent questions in the field of germination biology of seeds is what controls the timing of germination of seeds in soils. Many factors such as high level of carbon dioxide in soils, improper aeration, age of seeds, poor seed storage and production of volatile allelo-chemicals have been suggested to prevent germination of seeds in the soil (Holm, 1979).However, in many leguminous seeds, hard seed coat prevents imbibition of water and exchange of gases, thus preventing initiation of the germination process (Maguire,1975)

Karuiki and Powell (1988) defined Seed Germination as the process by which the dormant embryo grows out of the seed coat and establish itself as a Seedling. That is, Seed Germination involves the growth or transformation of an embryo of a mature seed into a Seedling. Germination is a component of seed quality and it occurs when a viable seed absorbs water, inducing respiration and protein synthesis, leading to the emergence of the plumule and radicle from the testa (Maguire, 1975).Germination incorporates those events that commence with up-take of water by the seed, followed by growth of the embryo, the rupturing of the seed coat and the emergence of a young plant. (Bewley and Black, 1994).

In order to germinate, a seed must fulfill the following requirements i) it must be viable ii) it must be subjected to appropriate environmental conditions and iii) any primary dormancy present in the seed must be over-comed.Seed Germination generally measured in percentage is the number of seeds usually out of 100 seeds in a seed lot that are expected to germinate and grow into healthy plants. Viable seeds does germinates when sown, but when they fail to germinate, despite provision of adequate water or moisture, light, temperature, gases, and other suitable materials, such seeds are said to be dormant or are said to exhibit dormancy.

Copeland and McDonald(1985) defined Seed dormancy as a state in which seeds are prevented from germination under environmental conditions normally favourable for germination.Seed dormancy is a block to the completion of germination of an intact viable seed under favourable conditions(Hilhorst,1995).

Osonubi and Chukwuka (1999) defined dormancy as the condition whereby seeds fail to germinate because of internal conditions, even though, external conditions such as oxygen, moisture or water, light and temperature are favourable.According to Baskin and Baskin, (2004), Seed dormancy is a state in which seeds are unable to germinate in a specific period of time under a combination of environmental factors that are normally favourable for germination.

A dormant seed is one that is unable to germinate in a specified period of time under a combination of environmental factors that are normally suitable for the germination of the non-dormant seed (Http.www.).Dormancy is a period of arrested growth or a period of rest preceding seed germination and a form of survival strategy by seed plants, a mechanism by which seeds can delay germination until the right environmental conditions for seedling growth and development subsist. It is a form of ecological adaptation for staggered germination because if seeds germinate all at once and if there is immediate catastrophe such as severe drought or epidemic diseases, all the new Seedlings will be wiped out at once. Dormant seeds attain physiological maturity for germination only after removal of factors imparting the dormancy.

Dormancy may be due to a variety of reasons such as

a) seed coat restrictions based on the seeds morpho-anatomical structure
b) chemical inhibitors within the seed (Physiological Dormancy)
c) light sensitivity
d) embryo dormancy(rudimentary embryo)

Any pre-treatment which reduces or destroys seed impermeability by weakening or softening the seed coat is known as scarification. Scarification treatment is used to soften the seed coat in order to make the seed permeable to water and gases without destroying the embryo (Seedbrock, 2006).

Pre-treatments used to break seed dormancy includes usage of nitric acid, sulphuric acid, other acids, and other chemicals, chipping, scratching or cutting through with blade, drilling, filing or knife, piercing or puncturing the seed coat with needle or any other sharp objects, grinding seeds with abrasives or brief immersion in hot water (wet heat),soaking in cold water, in dilute solutions of caustic soda, sodium hypochlorite, alcohols, hormone applications and solutions of various salts are being used, dry heat, chilling temperatures, different temperature regimes, drastic temperature shifts-alternating periods of low and high temperature pre-treatments or any other thermal scarification methods, electric, magnetic and pressure pre-treatments. physical scarification and stratification. (Gill, 1993, FAO, 1995).

Stratification is a simple and inexpensive technique for over-coming seed dormancy of temperate tree species mostly depending on the type of dormancy involved, warm stratification is applied for seeds that have immature embryos, cold stratification is used to break physiological dormancy. Combined warm and cold stratification is effective for seeds that have both immature embryos and physiological dormancy. Warm stratification involves the placing of seeds in a moist medium such as sawdust, peat-moss or sand, while cold stratification involves moist chilling of seeds. In the Tropics, seeds are stored in pots or containers with cool soil which causes removal of substances which delays germination as a stratification mechanism.

Since over –exposure of seeds to hot water can kill seeds, it is important not to soak seeds in hot water for too long, also acids can be very dangerous to handle and its usage requires personal protective gears and proper disposal after usage, also prolonged physical abrasion if not well monitored can damage the delicate seed embryo.

This research focuses on the breakage of seed coat dormancy of *Caesalpinia benthamianus.*Many leguminous plants are noted for their hard seed coat, their hard seed coat confers longevity, enabling them to survive harsh conditions, it also allows endozoic dispersal of their seeds and re-colonisation of their habitats after fires(Egley,1989).Fruits and seeds of most leguminous plants often develops a slit or an opening along one side of the pod, really, that is, the better time for planting purposes because when seeds are held in storage, there is gradual decline in their germination ability and vigour(Http.www.).

Objective of the Study

The objective of the study is to determine the influence of pre-sowing scarification treatments on *Caesalpinia benthamianus* using 98% Sulphuric acid(Chemical scarification) and rough abrasion (Physical scarification) with rough sand paper in order to enhance germination towards propagation of the plant for its traditional medicine value and other uses.

Background to the Study

Caesalpinia benthamianus plant extracts are useful in West African traditional medicine in the treatment of headache, sore-throat, catarrh, and troublesome coughs. The roots of *Caesalpinia benthamianus* crushed and admixed with those of *Paullinia pinnata* and put into palm-wine or taken with food are considered as aphrodisiac (Burkill,1995).

Statement of the Problem

There are no conscious propagation efforts on *Caesalpinia benthamianus*. There should be concerted efforts for the domestication and conservation of the plant.

Materials and Methods

Source of Seeds

Seeds based on availability were collected from Akungba-Akoko, Ondo State (Latitude). Viable seeds determined by floatation method were used for the experiment after Pandey and Sinha, 1972.

Study Site and Management

The Study was conducted at the Screen House of Plant Science and Biotechnology Department, Adekunle Ajasin University, Akungba Akoko. Seeds were sown in perforated white plastic buckets. Bucket diameter was 22cm and bucket depth from the base to the bream was 24cm.. Buckets were laid out in a complete randomized design.

Four replications of 100 randomly picked seeds-25 seeds per bucket were used for each treatment. Seed spacing was 2 x2 cm and at sowing depth of 3cm. Buckets were kept free of weeds and watering was ensured regularly throughout the study period.

Seed Pre-Treatments

100 seeds each were subjected to 98% Sulphuric acid (Chemical) and Physical abrasion treatments. Another 100 randomly picked seeds were sown as Control treatment based on seed availability.

Chemical (Acid) Scarification Treatment

This was done by immersing the seeds in 98% concentrated Sulphuric acid for 4 minutes, the acid was then decanted and rinsed several times in distilled water and sown.

Control (Un-Treated) Experiment

100 un-treated seeds chosen at random were sown as control experiment to ascertain the Emergent Percentage of intact viable seeds.

Physical Scarification Treatment

Seeds were physically abraded with rough sand paper for 4 minutes-2 minutes on either side and were sown.

Germination Counts

Seeds were recorded as germinated or emerged, once the plumule attains a height of 1cm above the soil surface after Missanjo *et.al.*, (2014).Records of seed germination were taken every day and observed for 30 days.

Germination Percentage/Percentage Seedling Emergence

Percentage Seedling Emergence recorded as number of seeds which germinated out of a sample of 100 seeds with or without treatment. It was calculated thus,

$$\% \text{ Seedling Emergence} = \frac{\text{Number of Emergent Seedlings}}{\text{Total Number of Seeds Planted}} \times 100$$

Mean Germination Time

Mean Germination or Emergent time was recorded as the average of summations of the number of days for all the germinated seeds

Statistical Analysis

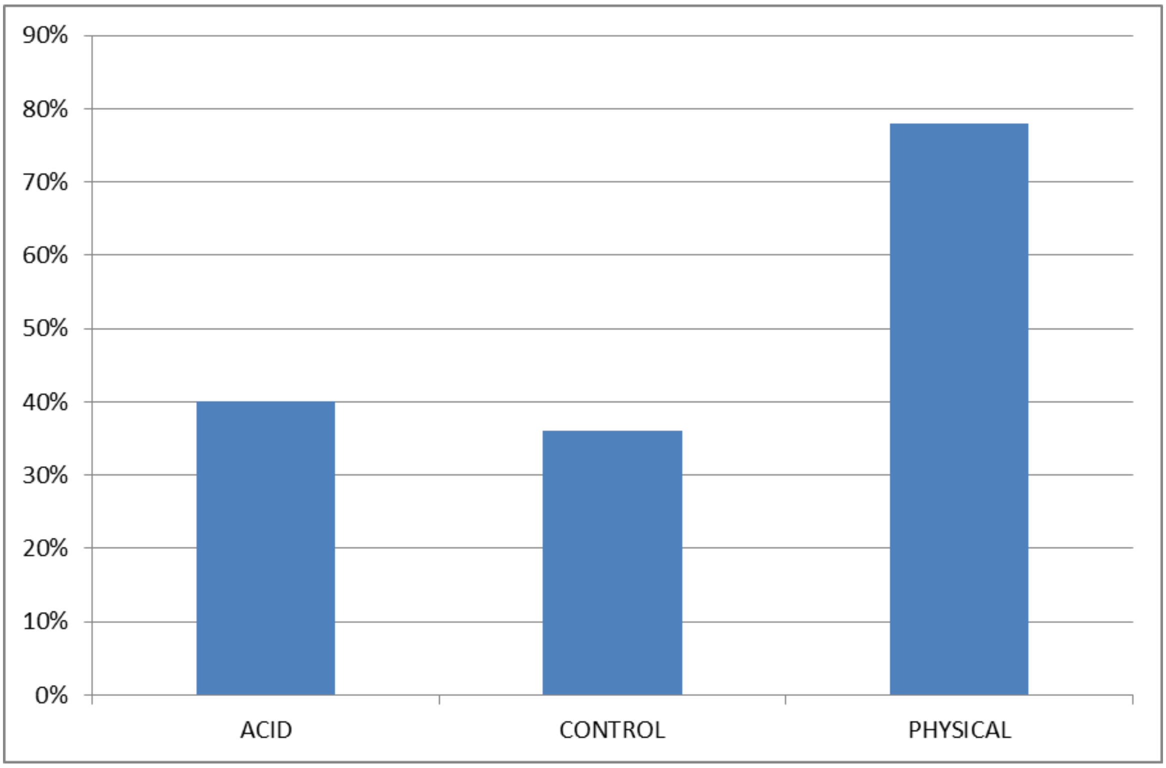
SPSS Analysis was used to calculate means of distribution and Standard Deviations.

Results

Data Presentation

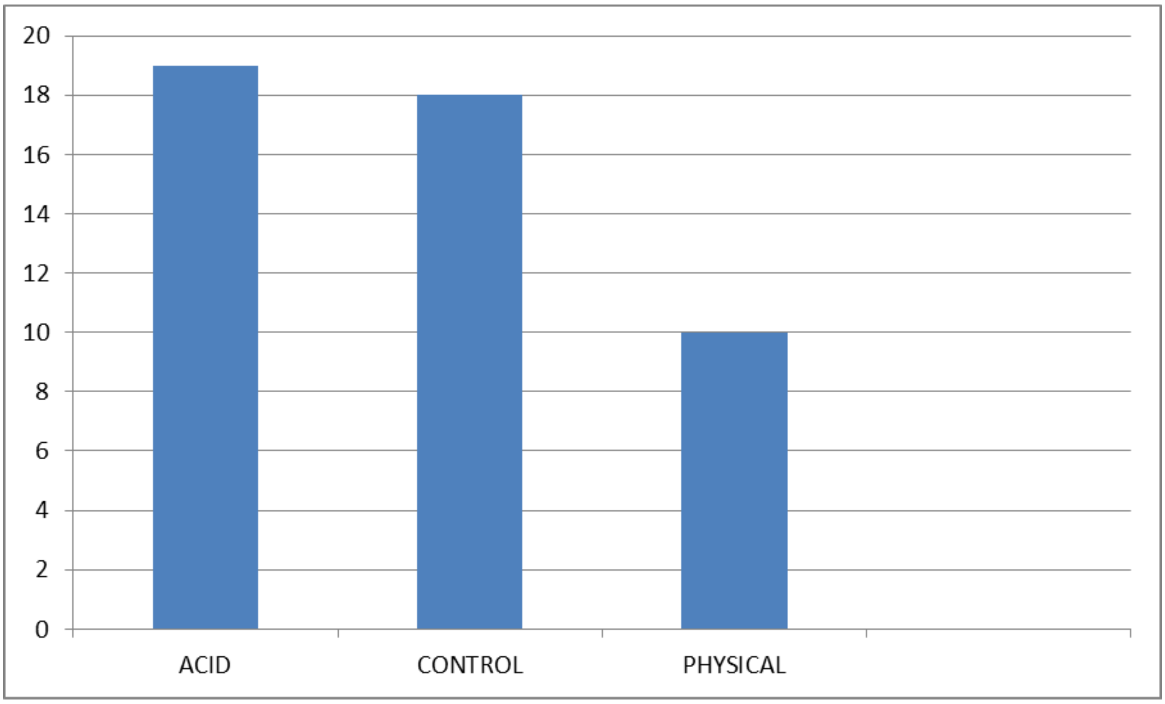
Table 1

Period of Treatment 4minutes			
Type of Treatment	Suphuric acid	Mechanical	Control
	1.30 ± 0.714	2.57 ± 0.199	10.53 ± 0.589
LSD $P<0.05$	0.000	0.000	0.760



Treatments

Fig.1: Effects of 4minutes pre-treatment on percentage Seedling emergence of *Caesalpinia Benthamianus.*



Treatment

Fig.2: Influence of 4minutes pre-treatment on Seedlings emergence rate of Caesalpinia benthamianus.

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