



Influence of pre-sowing treatments on *dichrostachys cinerea* and its agrihorticultural potentials

O.A.OBEMBE

Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria

*Corresponding author E-mail address: olutayobembe@aaau.edu.ng, olutayobembe@gmail.com

Abstract

Keywords:

Dichrostachys cinerea Seed
Pre-Treatments, Seed
Emergence Percentage,
Mean Emergence Time.

Dichrostachys cinerea (Linn) Wight and Synonym *Dichrostachys. Glomerata* (Forsk.) Chiov; commonly known as Sickle bush or Chinese Lantern tree belongs to the natural Order Fabales, Family Fabaceae and Sub-Family Mimosoideae. It's spike inflorescence are of two showy colours –pink and yellow flowers are faintly fragrant, very decorative and the finely divided feathery leaflets gives the tree an attractive appearance, thus it can be exploited as an ornamental plant. *Dichrostachys cinerea* exhibits seed coat dormancy. Seeds were sown in white plastic buckets filled with loose and well drained river sand at sowing depth of 3cm. Bucket diameter was 22cm and bucket depth from the base to the bream was 24cm. Buckets were laid out in complete randomized design. Four(4) replications of 100 randomly picked seeds-25 seeds per bucket were used for each treatment. Viable seeds determined by floatation method were subjected to pre-treatments using control, 98% Sulphuric acid, wet heat(boiled or hot water)and physical abrasion for 1,2 and 3 minutes. Results shows that 3 minutes physical scarification (56%)was most efficient with mean emergent time of 7.3 days. Control treatment gave 34% and mean emergent time of 8.4 days. Thus 3 minutes physical scarification pre-treatment with 56% emergence is recommended for the propagation of *Dichrostachys cinerea*.

Accepted: 17 June 2019

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INTRODUCTION

Ornamental horticulture or Floriculture is concerned with cultivating plants for decorative purposes, to satisfy the eye rather than for food. Floriculture has long been and will continue to be outlets for recreation and pleasure (Oloyede *et. al.*, 2007). Ornamental plants are those produced for their decorative values as flowers, turf grasses and landscape plants (Terill, 1994). Plants have aesthetic values owing to particular qualities like the attractiveness or beauty of their flowers, fruits, leaves and their aroma or fragrances (Desh,2011). This research endeavour focus on mass production of *Dichrostachys cinerea*, a tree plant whose centre of origin is Africa. *D. cinerea* is of great agrifloricultural potentials as a landscape plant, in bonsai and topiary.

Dichrostachys (A.DC) Wight and Arn Genus comprises 20 species of tropical African, Madagascar and Australian origin (Willis and Airyshaw, 1973).

Etymologically, the Generic name *Dichrostachys* means bi-colored spike inflorescence and *cinerea* refers to the greyish hairs on its stem bark. *Dichrostachys cinerea* is commonly called Kalahari Christmas tree (South Africa), Sickle bush because of the curved nature of its fruit pod and Chinese lantern tree for the showy nature of its flowers. The leaves of *Dichrostachys cinerea* is highly palatable to livestock and the tree plant is an excellent source of fuel wood. *Dichrostachys cinerea*, a thorny, semi-deciduous tree reaches up to 8 metres in height with a round crown. Spines are axillary, leaves are bi-pinnate, 4 to 8cm long with 5 to 15 pairs of pinnae, each with 12 to 30 pairs of leaflets. The terminal lower flowers of *D. cinerea* are hermaphroditic (bi-sexual) with a pistil and ten yellow stamens each, upper higher flowers of its hanging spike are sterile, reddish or pale purple with protruding staminodes. Pods are indehiscent, curiously tangled, twisted, spiraled or crowded, usually mustard brown in coloration when matured. People of Yoruba tribe,

Nigeria call the tree Kara (Burkill, 1995, Hutchinson and Dalziel, 1958, Keay, 1989).

D. cinerea focused here is one amongst other alphabetically arranged native and fairly naturalised trees of ornamental and resting shade potentials such as *Acacia nilotica*, *Alstonia boonei*, *Alstonia congensis*, *Berlinia grandiflora*, *Bombax buonopozense*, *Borassus aethiopicum*, *Cananga odorata*, *Cassia sieberiana*, *Cocos nucifera*, *Croton zambesicus*, *Daniellia oliveri*, *Dracaena mannii*, *Ehretia cymosa*, *Elaeis guineense*, *Entada africana*, *Erythrina senegalensis*, *Gardenia imperialis*, *Glyphaea brevis*, *Hildegardia barteri*, *Hollarrhena floribunda*, *Hura crepitans*, *Lawsonia inermis*, *Lonchocarpus sericeus*, *Markhamia tomentosa*, *Milletia thonningii*, *Moringa oleifera*, *Newbouldia laevis*, *Ochna afzelii*, *Polyceratocarpus parviflorus*, *Pterocarpus erinaceus*, *P. osun* and *P. santalinoides*, *Rauwolfia vomitoria*, *Rothmannia whitfieldii*, *Spathodea campanulata*, *Symphonia globulifera* and *Tabernaemontana pachysiphon* amongst other native tree plants of ornamental potentials.

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 ability of the embryo 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 seeds turn turgid, becomes physiologically active resuming active metabolism triggering cell growth and differentiation with polarized development into plumules and radicles (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 (Balasubramanian 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 (Balasubramanian 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 (Desh, 2011). 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 (Balasubramanian 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 and 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 (Missanjo *et al.*, 2014)

Karuiki and Powell (1988) defined Seed Germination as the process by which the dormant embryo grows out of the seed coat and establishes 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. 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. (Sen and Ghosh, 2010).

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 overcome. 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 do germinate 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 favorable 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.

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 addition of organic solvents such as acetone, alcohol and carbon disulphide, 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, manual abrasion 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 that 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 *Dichrostachys cinerea*. Many leguminous plants are noted for their hard seed coats, their hard seed coats confer longevity, enabling them to survive harsh conditions, allowing 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, indicating the better time for planting purposes because when seeds are held in storage, there is gradual decline in their germination ability and vigour (Sen and Ghosh, 2010).

The objective of the study is to determine the influence of pre-sowing scarification treatments on *Dichrostachys cinerea* using 98% Sulphuric acid (Chemical scarification) wet heat or hot water (thermal scarification) and rough abrasion (Physical scarification) with rough sand paper in order to enhance germination towards prolific propagation of the plant for its agri-horticultural potentials and other uses.

Dichrostachys cinerea bark and leaf extracts are useful in West African traditional medicine in the treatment of sore throat, catarrh and cough (Burkill, 1995), the plant is of great agri-floricultural potentials and can be exploited as an avenue tree, in bonsai and topiary. There are no conscious propagation efforts on *Dichrostachys cinerea*. There should be concerted efforts for the domestication and conservation of *Dichrostachys cinerea*, as a native ornamental.

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 the Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba Akoko, -Latitude 7¹ 27N and 7¹ 28S, Longitude 5¹ 44E and 5¹ 45W, Altitude 369metres. 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 (CRD).

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

Seed Pre-Treatments

One hundred (100) seeds each were subjected to 98% Sulphuric acid (chemical), hot water (wet heat) and Physical abrasion treatments. Another One hundred (100) randomly picked seeds were sown as Control treatment.

Chemical (Acid) scarification treatment

This was done by immersing the seeds in 98% concentrated Sulphuric acid for 1, 2 and 3 minutes, the

acid was then decanted and rinsed several times in distilled water, after which the seeds were sown.

Control (un-treated) experiment

One hundred(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 1,2 and 3minutes after which the seeds were sown.

Wet heat (hot water) treatment

Boiled water at 100⁰ Celsius was introduced to 100 randomly picked seeds, stirred for1, 2 and 3minutes after which the seeds 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 40 days.

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

Statistical Package for Social Sciences (SPSS)Analysis were used to calculate means of distribution and Standard Deviations.

RESULTS

Table 1 shows Statistical inference of the effects of pre-sowing treatments on *Dichrostachys cinerea*. Figure 1 shows that 3minutes physical scarification with 56% Germination was most effective relative to acid (37%), control treatment (34%) and lastly wet heat (22%), while Figure 2 shows also that 3minutes physical scarification shows fastest mean emergence time of 8.4days,control with mean emergence time of 8.5days, acid treatment (10 days) and wet heat with the slowest mean emergence time of 14.8 days.

Data Presentation

Table 1: Period of Treatment Sulphuric Acid Boiling

Physical Scarification				
1minute	5.46 ± 0.656	9.32 ± 0.742	4.46 ± 0.270	
LSD (P<0.05)	0.001	0.000	0.138	
2minutes	6.72 ± 0.686	9.52 ± 0.486	3.45 ± 0.341	
LSD (P<0.05)	0.001	0.001	0.000	
3minutes	5.42 ± 0.502	7.77 ± 0.382	3.89 ± 0.336	
LSD (P<0.05)	0.001	0.001	0.006	
Control				
	R1	R2	R3	R4
	3.75 ± 0.491	3.40 ± 0.812	3.36 ± 0.650	3.29 ± 0.474
LSD P<0.05	0.638	0.970	0.970	0.912

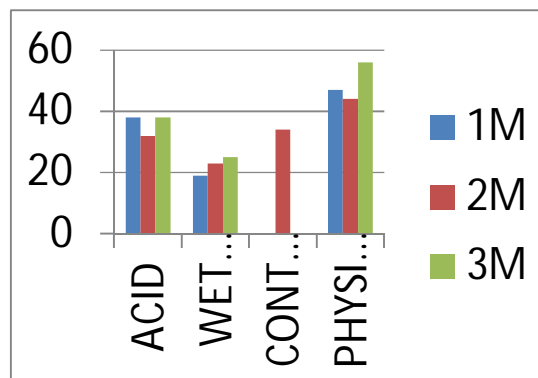


Fig 1: Effects of 1, 2 and 3minutes Pre-treatments on Percentage Seedling Emergence of *Dichrostachys cinerea*.

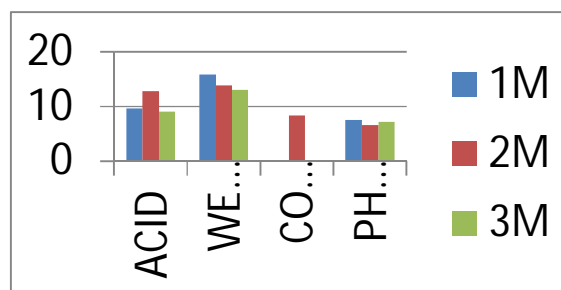


Fig 2: Influence of 1,2 And Three Minutes Pre-sowing Treatments on Seedling Emergence rate of *Dichrostachys cinerea*.

DISCUSSION

Results of the experiment shows that impervious seed coat may be the cause of dormancy in *Dichrostachys cinerea* The breaking of seed coat dormancy in legumes using Sulphuric acid, hot water(wet heat) and physical abrasion amongst others have been demonstrated by other works (Ajiboye and Agboola, 2010, Ajiboye *et. al.*, 2011, Missanjo *et .al.*, 2014). Copeland (1976), Ajiboye *et.al.*,2011, reported that hard seed coat creates barrier to water up-take and entry of gases in most legumes,stating that imperviousness in the seeds of most legumes may be due to deposition of cutin, lignin and suberin in the seed coat membranes or across the micropylar opening of the seed. Presence of continuous layer of tightly packed palisade cells in the seed coat of legumes may also create barriers to water and gases up-take (Egley, 1989,Missanjo *et.al.*,2014). Physical scarification under laboratory conditions here may explain how abrasion of the seed coat by ploughing, harrowing and charring by field burning overcomes hard seed coat dormancy in nature.

CONCLUSION

Conclusively, comparative effectiveness of 40 seconds Physical scarification treatment with 53% Germination and most reduced spread of days with Mean Germination Time of 13 days and its low resources demand makes it more economical and more result

oriented treatment for the propagation of *Dichrostachys cinerea*.

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