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Effect of Seed Source on Germination and Early Seedling Growth of *Heinsia crinita* (Afzel.) G. Taylor

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ABSTRACT

Seed germination and early growth rates of Heinsia crinita from four sources in Nigeria were conducted. Seeds of H. crinita were collected from Benin, Port Harcourt, Umuahia and Calabar and examined for variation in germination performance and early seedling growth attributes. A total of 400 seeds (4 replicate of 100 seeds) per location were sown and germination was monitored every day from the date of sowing for 30 days or until there was no further germination for a few days. Following germination, fifty (50) seedlings at uniform height from each location were selected and transplanted into polythene bags filled with topsoil collected from forest floor. The growth parameters such as root and shoot length, leaf area, leaf production and seedling biomass were assessed at six months after planting. Analysis of variance revealed significant difference ($p < 0.05$) in germination of seeds from the different sources as well as significant differences ($p < 0.05$) in all studied growth attributes of the seedlings from the different seed sources after 6 months of growth. Seeds from Calabar gave the highest germination percentage (92%), followed by seeds from Umuahia (86%) while the lowest germination percentage (54%) was recorded for seed from Benin City. Commencement of germination was earliest (8 days after sowing) in Calabar seed source, which was closely followed by seeds from Umuahia that commenced germination 10 days after sowing. Seedlings from Calabar seed source had the highest mean values for all the seedling growth attributes investigated. There was significant difference in the dry weight seedlings from the different seed sources at 0.05 significant level. Seedlings from Calabar seed source produced the largest amount of dry weight (3.34 g plant-1), while seedlings from Benin City seed source had lowest dry weight of 1.67g plant-1. Seed sources with higher longitude tend to perform better in terms of germination and produce seedlings with better growth attributes. The study has shown that the choice of an appropriate seed source is an important process in restoration and domestication of the plant species.

Key words: Seed source, germination percentage, seedling growth attributes, *Heinsia crinita*

INTRODUCTION

Heinsia crinita, which belongs to the family Rubiaceae, is a shrub that grows up to 3m tall. *H. crinita* is commonly found on cultivated land. The leaves are opposite, elliptic to ovate, hairless except for some hairs on the midrib and small domatia below (Dalziel, 1994). The leaves are used as vegetable/flavouring, called atama in south-eastern Nigeria and very popular in south-south geopolitical zone of Nigeria. The Flowers are bisexual, sweetly scented, terminal, solitary or in few flowered clusters. Fruit is ellipsoid with a crown of persistent, leaf-like calyx lobes, yellow when ripe. The yellow fruits are edible. The species is also used in traditional medicine for various ailments such as, diarrhoea, dysentery, paralysis, epilepsy, convulsion and reduction of high blood pressure (Keay, 1989; Burkill, 1985 and Dalziel, 1994). It can also be used as pain killers and in treating venereal diseases (Burkill, 1985).

A seed source refers to the source of seed for planting. Seed sources should represent the best available genetic material for planting as exhibited by the parental material (Mbora *et al*., 2009). Seed source testing of native species is necessary to screen the available variation for higher productivity and future breeding work. Selection of the best seed source of a desired species for a given site or region is necessary to achieve maximum productivity in plantation forestry (Takuathung *et al.*, 2012).However, such studies on *H. crinita* are lacking in Nigeria. This constitutes a major problem in conservation and domestication of this species. Furthermore, the silvicultural characteristics of *H. crinita* are not well known because the species has not been subjected of much study. Hence adequate information on the silvicultural characteristics such as germination pattern and seedling growth rate would facilitate its conservation and domestication.

Differences in seed germination patterns and seedling growth rates of seedlings may be due to climatic and geographic influences or, more importantly, even genetic differences (Weinert *et al*., 1990). Previous genetic studies on economically useful tropical plantation species such as Gmelinaarborea Roxb., Tectonagrandis L.f., and Heveabrasiliensis (Willd. ex Adr. de Juss) Muell. have documented the existence of substantial genetic variation in natural populations for a variety of quantitative traits (Alika, 1980; Jayasankar *et al*., 1999; Hodge and Dvorak, 2004; Lauridsen, 2004). It is generally assumed that populations within the same regions of provenance are derived from the same random mating or base population (Stern and Roche, 1974). The genetic component of this variation among populations from different regions can, therefore, be identified by testing different seed sources and exploited through selection of superior populations for seed collection.

Quality seed has been recognized as an important input in forestry and is considered essential for increasing production. Seed polymorphism has been found to play a major role in seed germination as well as in the survival and seedling growth (Pathak *et al*., 1980). Source variation tests are necessary to screen the naturally available genetic variation to select the best planting material for higher productivity (Bhat and Chauhan, 2002) and select suitable genotypes for future breeding programmes (Mamo *et al*., 2006). Such an investigation may also help in early evaluation of criteria for selection of some prominent traits both in the laboratory and nursery conditions, which may be related to subsequent performance in the field (Ginwal *et al*., 2005). In this study, the effect of seed source in the germination and early growth of *H. crinita* seedlings were investigated. Such investigation will provide some information on the biology of the species for regeneration and conservation.

MATERIALS AND METHODS

Seed collection

Seeds of *H. crinita* were collected from four sources, representing agro ecological zones of Nigeria. The geographic locations and climatic conditions of the different provenances are given in Table 1.Matured *Heinsia crinita* fruits were collected from ten plus trees in each location, which were randomly selected from traditional agroforestry farms. The fruits from each source were bulked together, the seeds were then extracted and four hundred (400) viable seeds selected for germination experiment, resulting in a total of one thousand six hundred (1600) seeds from all the four locations for this study.

Table 1: Geographic locations and climatic conditions of the different sources of *Heinsia crinita* seeds

Provenance	Location (Lat. and Long.)	Altitude above sea level (m)	Rainfall (mm)
Benin City	6.33^0N – 5.64^0E	86	2226
Port Harcourt	4.78^0N – 7.03^0E	16	2231
Umuahia	5.53^0N – 7.48^0E	152	2400
Calabar	4.97^0N – 8.34^0E	6.14	2986

Experimental design and data analysis

The experiment was laid in a Completely Randomized Design (CRD) in four replicates with seed sources as treatment and only source of variation. Four hundred (400) seeds per location were sown (i.e. 100 seeds in one replication). Observation for seed germination was done daily, starting from the first day of sowing for 30 days or until there was no further germination for a few days. Each seed was directly sown in a germination tray measuring 45 cm x 30 cm x 10 cm, filled with sterilized sharp sand and were kept moist by watering daily. Seeds were germinated under a 50% light shade net. No fertilizers or bacterial and/or mycorrhizal inoculation was used. One month after seeds were sown, fifty (50) seedlings at uniform height from each location were selected and transplanted into polythene bags (25 x 15 x 10cm) filled with topsoil collected from forest floor. The growth parameters such as root and shoot length, leaf area, leaf production and seedling biomass were assessed at six months after planting. Root and shoot lengths were measured using a meter rule; leaf area was measured using a plant planimeter; leaf production was determined by directly counting the number of leaves; while seedling biomass from dry weight of seedling was measured using using an electronic weighing balances. Height Data were analyzed using Statistical Package for Social Sciences (SPSS) for windows (version 17.0).

RESULTS AND DISCUSSION

Germination Performance

The results show that the germination of *Heinsia crinita* seeds from different sources was significantly different (Table 2). The highest seed germination percentage (92%) was obtained from Calabar seeds, which was followed by seed from Umuahia (86%), while the lowest germination (54%) was obtained from seeds from Benin City (Table 2). The difference in germination percentage can be attributed to the effect of seed source. This is in agreement with the work of Loha *et al*. (2006), who opined that seed germination capacity is due to provenance effect. Similarly, Gosh and Singh (2011) also revealed the influence of seed source on germination performance. In most plant species, seeds vary in their degree of germinability between and within populations as well as between and within individuals (Benowicz *et al*., 2000, 2001; Gera *et al*., 2000; Sivakumar *et al*. 2002; Thomsen and Kjær 2002; Mkonda *et al*., 2003). Some of these variations can be of genetic origin, but much of it is known to be phenotypic, i.e. caused by the local conditions under which the seed matured. Apart from seed source, which is due to geo-climatic variables of seed origin, other factors cannot be ruled out. Fenner (1991); Andersson and Milberg (1998); Bhatt *et al*. (2000) and Gutterman (2000) reported that the germinability of seeds can be markedly influenced by maternal factors, such as position of the seed in the fruit/tree and the ageof the mother plant during seed maturation, as well as environmental factors.

Table 2: Germination performance of *H. crinita* seeds from din the nursery

Provenance	Germination Percentage (%)	Commence ment of Germination (Days)	Germination Duration (Days)
Port Harcourt	66^c	12^a	20^c
Benin City	54^d	12^a	20^c
Umuahia	86^b	10^a	18^b
Calabar	92^a	8^a	12^a

There was no significant difference ($p > 0.05$) in the time of commencement of the germination of *Heinsia crinita* seeds from the different sources (Table 2). Seeds from Calabar had the earliest fastest germination time of 8 days after sowing, which was followed by seeds from Umuahia that started germinating 10 days after sowing. Seeds from both Port Harcourt and Benin City started germinating 12 days after sowing. Germination duration for the different seed sources ranged from 12 to 20 days after sowing (Table 2). The results of mean separation showed that germination duration for seeds from Calabar is significantly lower ($p \leq 0.05$) than those of seeds from the other locations (Table 2). Differences in germination values of the different seed sources are in conformity with those reported by for Fir and Spruce (Singh and Singh, 1981), *Acacia* spp (Mathur *et al*., 1984) and *Albizia falcataria* (Bahuguna *et al*., 1989). This difference in germination performance due to different sources of seeds could be attributed to longitudinal location. Loha *et al.* (2006) reported that speed of germination, as determined by the germination energy has significant positive correlation with the longitude of the seed source. Similarly, significant differences in germination ability of a species from different sources have been reported for several species of Central Himalaya (Witcombe and Whittington, 1972; Bewley and Black, 1994).

Seedling Growth Characteristics

The mean shoot length of seedlings from Benin City varied significantly ($p \leq 0.05$) from those from Calabar, Umuahia and Port Harcourt provenances (Table 3). Seedling of Calabar origin had the highest mean shoot length of 41.43 cm while seedling of Benin City origin had the lowest mean shoot length of 16.10 cm (Table 3). The mean root length ranged from 5.37 cm to 15.14 cm, irrespective of seed source. There was significant difference ($p \leq 0.05$) in mean root length of seedlings from the different sources. Seedlings from Calabar seed source had the highest mean root length of 15.14 cm followed by Umuahia, with 13.45 cm while seedlings from Benin City source had the lowest root length (5.37 cm). The collar diameter of the seedlings was significantly influenced by seed source. The results of mean separation revealed that there was no significant difference between collar diameter growth of seedlings from Umuahia and Calabar seed sources. The Seedlings of Calabar origin had the highest collar diameter of 3.03 mm, followed by seedlings of Umuahia origin (3.02 mm). Seedlings of Benin City origin had the lowest mean collar diameter of 1.17 mm. Glover (1987) reported similar trend, that seedling root growth patterns generally follow the same trend of height growth patterns. Experiments conducted by Amara (1987) showed that the provenance which exhibited faster height growth was also characterized by quicker collar diameter growth. The performance of a provenance depends partly on the site and seed source (Glover, 1987; Chadhar, 1994).

Table 3: Growth characteristics of *H. crinita* seedlings from different seed sources

Seedling parameter	Port Harcourt	Benin City	Umuahia
Shoot length	27.82 ± 3.68^b	16.10 ± 2.10^c	39.48 ± 2.35^a
Root length	9.28 ± 1.23^b	5.37 ± 1.32^c	13.45 ± 1.26^a
CD (mm)	2.55 ± 0.43^b	1.17 ± 0.16^c	3.02 ± 0.55^a
Leaf number	11.50 ± 0.50^a	10.90 ± 0.09^b	12.10 ± 0.64^a

All lengths are in cm, CD: Collar diameter

The seedlings from the different seed sources revealed significant difference ($p \leq 0.05$) in the mean leaf number (Table 3). The mean number of leaf ranged from 10.90 to 12.12. Leaf area per plant was significantly different among seed sources (Table 3). Calabar seed source had a significantly higher leaf area per plant (153 cm^2) than seedlings from the other seed sources (Table 3). Significant differences existed in dry weight of the seedlings from the different seed sources. Seedlings from Calabar seed source produced the largest amount of dry weight (3.34 g $plant^{-1}$), followed by the seedlings from Umuahia (3.00 g $plant^{-1}$). Port Harcourt and Benin City seed sources had seedlings dry weight of 2.17 and 1.67g $plant^{-1}$, respectively. Hazara and Tripathi (1986) reported that biomass production is a function of the photosynthetically active radiation on the leaves. As optimal leaf mass levels increases, biomass production would substantially increase. Due to higher leaf area and leaf dry weight, Calabar and Umuahia seed sources may have higher potential for photosynthetic carbon fixation. This was reflected by the larger amount of dry matter production (shoot and root) by seedlings from these seed sources in comparison with those from the other seed sources. Differences in the seedlings dry weight, therefore, can be attributed to the differences observed in and the growth parameters. This finding is consistent with those reported for *Acacia* spp (Mathur *et al*., 1984).

It was observed in this study that was a common trend in all the seedling growth attributes for all seed sources. This observation, however, is at variance with the findings of Aslan (1975) and Isik (1986) for *Pinusbrutia*, Manga and Sen (1996) and Arya *et al.* (1992) for *Prosopis cineraria* and Negi and Todaria (1997) for *Terminalia spp*. and *Sapindus mukorossi*, who observed that high-elevation (altitude) provenances produced larger and better quality seedlings than low-elevation populations. Furthermore, the significance of seed source on *H. crinita* indicates population diversity in the species.

CONCLUSION

Findings from the present study provide evidence that seed germination and seedling growth parameters vary considerably among different H. crinite seed sources. The significant difference in seed germination performance was attributed to the effect of seed source. The seedlings growth parameters were also significant for the different seed sources. Seed sources with higher longitude tend to perform better in terms of germination and produced higher quality seedlings. This finding is useful in the seed collection practices. This will prevent the use of poorly adapted genotypes for restoration and domestication programmes. Further research is necessary to determine whether seedlings which grew in the nursery will survive and grow well when planted in the field. Finally, selecting and analysing additional seed sources in future studies could be considered in order to get more precise relationship with geographic information.

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