



## Research Paper

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# Seed germination, early growth and biomass prediction of locally sourced *Terminalia brownii* in Turkana County, Kenya

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## ABSTRACT

Level at which our forest and underneath vegetation cover is lost is increasing more so in the arid areas. It is due to this reason that concerned sectors are forging plans for afforestation and rehabilitation of the degraded areas in dry lands especially Turkana. Promotion of indigenous tree species such as *T. brownii* is key in the rehabilitation of degraded areas because it has the capacity to withstand and adapt to the hot-dry climate of the region. The study's main objective was to evaluate the seed germination, early growth characteristics and make biomass prediction for *T. brownii*. This was achieved through proper handling and planting of pre-treated seeds by soaking in cold water for 24 h and sowed in the nursery potting tubes and provided with optimum requisites conditions for germination. The seedlings growth data were collected through observation and measurement of heights and the root collar diameter. The seedlings data was analyzed using R-Stats and the graphs plotted for comparisons. The final results showed 48% germination rate, indicating that viability from the wild is currently the best source and hence, need for enhanced breeding.

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## INTRODUCTION

Forests exploitation in the tropics is at a higher rate than reforestation with this exploitation observed to be increasing (Kapula, 2016). Deforestation and forest degradation have been major factors that threaten forest productivity, vegetation cover and sustainability due to the impending and increasing demand for forest and forest resources as a result of increasing world population (Kapula, 2016). Through this process of human needs satisfaction, issues such as climate change are now becoming top notch topics around the globe (Kapula, 2016). This particular tree species has the potential to produce high biomass and a good one when integrating in croplands in drylands (Simons, 2013). This is so as to restore soil quality, ground cover and biodiversity in degraded lands, while growing food crops as well as to help in carbon sequestration from the atmosphere (Ospina, 2017). Forests have primarily been seen as wood-producing

units and other products have conventionally been referred to as non-wood products ( , 2004). Forest products may also be commercially important at a local level, where they are traded in markets and shops or are sent to the larger towns and cities (Falconer, 1990; Oliver, 1999). Arid and Semi-Arid Lands (ASALs) inhabitants use these tree resources for the construction of housing structures locally referred as "Manyattas" and additionally for the provision of fuel wood (Synott, 1979). Availability of these resources hence becomes a major booster of people's livelihoods as well leads a major critical role in environmental protection (Blay, 2004). Additionally, forests are regarded to have connections with cultural practices of pastoral communities, hence the belief that striking the floor using *Terminalia* stick improves harvest (Coates-Palgrave, 1977.). In Africa, fuel wood is often the only available and affordable sustainable source of

energy especially for the less privileged households and accounts for almost 90% of primary energy consumption (FAO, 2010). Most Kenyan forests is under pressure as the land best suited for forest production is also good for agriculture hence brings about land fragmentation and reduction of forest cover (Pellikka and Clark, 2004). To counter such scenario, tree resources that have meaning to communities and the socio-economic aspect need to be introduced thus a shift from commercial re-forestation programmes to community involvement which will then be a sustainable approach for long-term benefits (Pahkasalo, 2004).

*Terminalia* species are commonly planted to establish Agri-silvicultural systems which provide shade and increase the soil fertility (Nichols DL, 2001). They stand to be the major provider of feeds for livestock (Owen-Smith, 1987). The leaves are highly browsed particularly during drought seasons (Ellery, 1997.) The wood is used for construction of buildings due to its timber being termite resistant, traditional medicine, furniture, plywood, fence posts, fuel wood, utensils, beehives and for charcoal production (Schmidt, 2002).

Turkana is one of the ASAL region promoting indigenous tree species to help in rehabilitation of these degraded areas. This is achieved through promotion of native tree species such as *Terminalia brownii* which can withstand the nature of these climatic conditions. The germination trial of indigenous tree species is important in that it helps in identifying the seed viability, solving range of issues such as breaking seed dormancy. The trials help in advising on the best, fastest and reliable methods to use when conducting a successful germination of selected species. It also enables one to undertake controlled experiments to aid in assessing tree species performances in various eco-regions. In addition, seedling monitoring helps in tracking the species growth and performance which helps in generating equations to compare species in different habitats. This further helps in determining the significant amount of weight and energy stored in the seedlings. The trial's first objective was to assess the seedling germination, early growth performance and thereafter use these data to make biomass predictions of *T. brownii* species in Turkana in a controlled environment. The study in addition aimed at assessing the effectiveness of *T. brownie* seed germination from local seed sources.

## MATERIALS AND METHODS

### Study area

The germination trial study was conducted at the KEFRI Turkana Research Station nursery, Turkana County located at 3.112550°N 35.599170°E. The area is categorized as an arid zone, characterized by high temperatures that range between 30-32°C, infertile soil and

average precipitation of 300-350mm annually (weatheronline.co.uk, 2018). The pH of the soils prepared for germination was averaging 5.6. The main dominating tree species are: -*Acacia* spp, *T. brownii*, *Diospyros scabra*, *Azadirachta indica*, *Bambusa vulgaris*, *Jatropha curcas*, *Cordia sinensis*, *Senna siamea* etc. which primarily help the young growing seedlings by providing adequate shade which is one of the requirement for seed germination as it protects them from extreme sunlight. The nursery has a perimeter fence to offer protection from browsing animals.

### Procedure

The materials used for the experiment included: Wheelbarrow, hose pipe for watering, spade, soil scooping metal, recommended potting tubes, Vernier caliper, Ph tester machine, 30 cm ruler, *T. brownii* seeds sourced from the nearby Loima hills, and water source. Afterwards, seed extraction was done so as to prepare the seed for sowing. In most countries, the seed extraction exercise is done manually, despite it being time consuming. In some species fruit drying is done to ease opening of the seeds (Shakacite, 1987). Soil was mixed in a ratio of 5:3:2 the ratios being forest soil, sand and manure, respectively. The potting tubes were filled with soil after which sowing was done two days later. Watering and subsequent monitoring was done on daily basis.

### Data collection

The data were collected through measurements of seedlings height and Root Collar Diameter (RCD) plus an addition of physical observation of the early growth characteristics of the *T. brownii* seedlings. The data were tabulated using Microsoft Excel and analyzed using R-stat to determine means of variables.

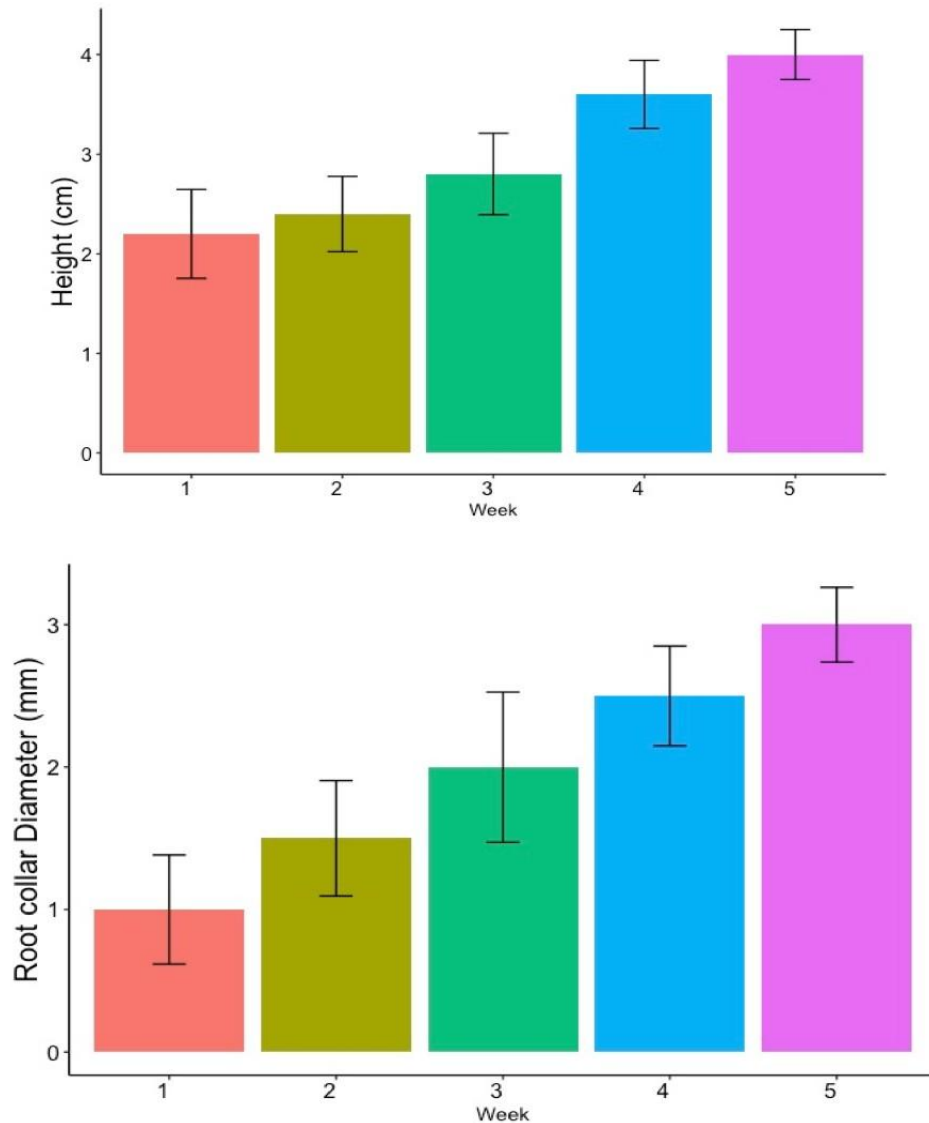
## RESULTS

The total number of germinations was 48%. The data of germination showed 11 seedlings shot up on the second week making 23% for the germination with the fifth week having the lowest germination at 17%.

From the data collected, it was observed that by the fifth week *T. brownii* showed a higher mean height of 4 cm as compared with the rest of the weeks, the first week showing the lowest of 2.2 cm (Figure 1 and Table 1).

The mean RCD was high in week five, showing a mean of 3 mm while the first week recorded a low RCD value of 1 mm (Figure 1 and Table 1).

The growth curve showed correlation coefficient of 0.94 in the 5-week study with a linear regression line



**Figure 1:** Weekly mean heights (cm) and weekly mean Root Collar Diameter (mm) of *Terminalia brownii* seedlings in the early growth phase.

**Table 1:** Showing mean early growth height and RCD for *Terminalia brownii* in Turkana, Kenya.

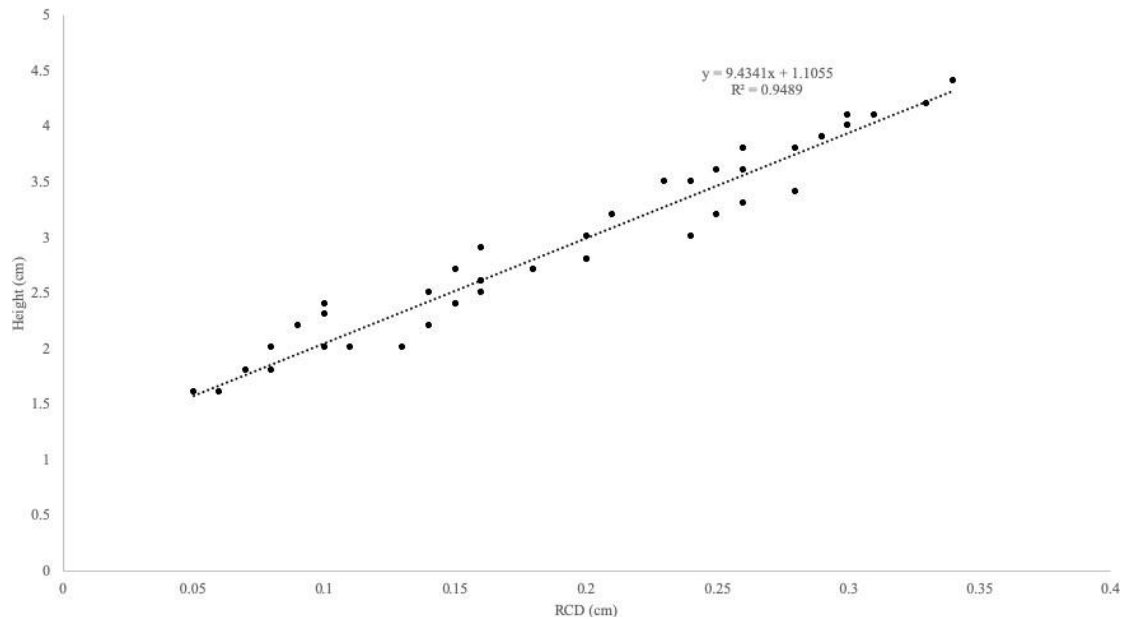
Week	1	2	3	4	5
Mean height (cm)	2.2±0.14	2.4±0.11	2.8±0.13	3.6±0.11	4±0.09
Mean RCD	1±0.12	1.5±0.12	2±0.17	2.5±0.12	3±0.09

(Figure 2).

## DISCUSSION

The findings of the trial show an average germination performance (Approximately 50%). This is justified from the total number of seeds germinated after all requisites for germination have been provided. The average germination

trial performance may have been contributed by the low seed viability. Study conducted by Weber (1986) highlighted that seeds of *Terminalia* species normally experiences series of dormancies before realizing the first shoot up. This calls to question the nature of seed collection to improve germination. It's further argued that seeds collected from the ground are not suitable for trials seeking faster germination as the seed's life is tempered with (Browse, 1979).



**Figure 2:** Height against RCD for early growing (6 weeks) *Terminalia Brownii* seedlings in the nursery.

The results of the trial additionally showed that the fifth week displayed a significantly higher mean RCD and mean heights as compared with the other weeks of germination. First week of germination recorded lower mean Heights and RCD and as such, longer studies be done to estimate further growth.

This study's findings presented in weekly biomass graphs revealed that linear regression equations displayed is the best model to be considered for early growth as it showed the highest correlation coefficient and as such recommended by Forest National Corporation for assessment of environmental characteristics of tree (Hatim Mohammed, 2015).

## CONCLUSIONS AND RECOMMENDATIONS

The average germination performance can thus be improved by collecting seeds directly from the twigs since previous studies argued that seeds collected directly from the ground rarely lives long thus affects seed germination. Additionally, it's imperative to ensure the trial undergoes alternative pre-treatments for instance nicking and scarification methods so as to attain faster germination rate. This study thus recommends long term analysis of *T. brownii* to determine if the regression coefficient would remain linear.

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