Australian Journal of Science and Technology

ISSN Number (2208-6404)
Volume 5; Issue 2; April 2021

Original Article

Influence of light intensities and provenances on seed germination and growth potentials of *Bombax costatum* Pellegr. and Vuill.

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ABSTRACT

The light requirement for seed germination and seedling growth varies from species to species. Therefore, the effect of light intensity on seed germination and growth potentials of *Bombax costatum* seedlings was investigated. Seeds were collected from four provenances (Aponmu, Oluwa, Ibadan, and Oyo) in Southwest Nigeria. Twenty-five seed lots in six replicates from each provenance were subjected to two treatments (bright light exposure and dark exposure). Uniform seedlings from four provenances were thereby subjected to 25%, 50%, 75%, and 100% light intensities. The experimental design was 4 × 4 factorial replicated 6 times. Plant height, collar diameter, leaf production, and leaf area were assessed fortnightly for 12 weeks. Germination percentage was determined and relative growth rate (RGR), absolute growth rate (AGR), and net assimilation rate (NAR) were estimated from seedling growth. The germination exhibited positive photoblastism with highest germination percentage (88.0%) from Oluwa provenance followed by Oyo (85.5%), Aponmu (85.3%), and Ibadan (81.3%) under light condition. Seeds in the dark condition had the least germination percentage of 61.3% (Oluwa). The effect of light intensity and provenance on plant height, collar diameter, leaf production, and leaf area of seedlings of *B. costatum* was significantly different ($P < 0.05$). The treatment with 75% light intensity gave highest results in mean plant height (33.3 cm), collar diameter (0.5cm), leaf production (7.2), and leaf area (138.4 cm^2). Furthermore, highest RGR (6.0×10^2), AGR (6.5×10^{-1}), and NAR (6.2×10^{-3}) were recorded for 75% light intensity treatment. *B. costatum* is found to be positive photoblastic, therefore, for optimum germination of *B. costatum* seeds and seedlings growth, provision of appreciable light of 75% light intensity is recommended.

Keywords: Photoblastic, Light intensities, Provenances, Growth rate, Germination

Submitted: 18-03-2021, **Accepted:** 07-05-2021, **Published:** 30-06-2021

INTRODUCTION

The importance of light on survival cannot be overemphasized. It is needful for almost all processes or features of seed such as seed preservation, storage, germination, rooting, leaf production, and fruiting.[1] The most known function of light involves photosynthetic process;[2] in which light is used to make natural food for the trees. Light is the one of the major factors influencing seed germination including temperature and soil moisture.[2] For the purpose of seed germination, seeds use light to detect if they are close to the soil surface, this is especially important in the case of small-seeded species, because small seeds have limited resources and these seedlings could not emerge successfully if they germinate too deep in the soil.[3,4] In addition, light helps to alleviate the adverse effects of germination when the incubating temperature is higher than what is favorable.[5]

The sensitivity of plant seeds for germination can be basically divided into three categories. These include positive photoblastic which is categories of plant seeds that require light to germinate; negative photoblastic that requires darkness to germinate while neutral photoblastic is plant seeds that have a large percentage of seeds neutral to light.[6,7] Seed germination is an irreversible process that commits the embryo to only two possible outcomes, death or growth.[3] The inhibition of seed by

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lack of light to germinate near the soil surface can influence its survival during dry conditions. At the same time, the need for direct light for germination enables seeds to germinate under less competitive situations.[8,9]

Seed germination and growth are controlled by both internal and external factors. These factors include morphological (size, form, and stiffness) and physiological (age, photoblastism, and dormancy) as internal factors of seeds which interact with the external factor which is ecological variables (light, temperature, moisture, soil quality, and seed predation). This interaction between the internal and external factors determines the local abundance of plant species.[10-13] Likewise, two forces (phytohormones) are working simultaneously but in opposite direction during seed germination. Production of gibberellins induces germination, while accumulation of abscisic acid negatively regulates this process and is responsible for dormancy.[14-16]

There are several factors that influence plant growth and nutrient availability, plant growth and development are usually affected by internal ecological regulations that are modified by environmental conditions such as light, temperature, water, and humidity.[17] Among these factors, light is very critical for healthy development and survivals of seedlings.[18]

Researches into important environmental factor such as light intensity variations which can limit the growth rate of plants need to be carried out so as to determine the optimum light required for raising vigorous *Bombax costatum* seedlings. There has been dearth of information on the light requirements for seed germination of *B. costatum* and effect of varying light intensity on the early growth of its seedlings. This study, therefore, assessed the germination of *B. costatum* seeds in response to light and the seedling growth under different light intensities.

MATERIALS AND METHODS

Seeds of *B. costatum* were collected from four provenances in Southwest Nigeria. The four provenances were located within the rainforest zone of the country. There are Aponmu (latitude 7° 20' N and longitude 5° 30' E), Oluwa (latitude 6° 55' N and 7° 20' N, and longitude 3° 45' E and 4° 32' E) in Ondo State, Ibadan (latitude 7° 26' N and longitude 3° 54' E), and Oyo (latitude 3° 55' N and 4° 42' N) in Oyo State.

Twenty-five trees were sampled from each site. The trees were numbered serially with red paint. All the selected trees were growing naturally and the tree species were within 100 m apart. Seed was collected from the base and middle portion of the crown.

Experimental Procedure

Effect of light on seed germination

Freshly collected seeds from each provenance were thoroughly mixed and 25 seed lots in six replicates from each provenance were used for the experiment. Seeds were surface sterilized with 0.1% mercuric chloride solution for 1 min and thoroughly washed in distilled water.[19] The seeds were laid on Whatman No. 9 filter paper and placed on transparent glass sheets inside two Copenhagen germination tanks at the seed store laboratory of Forestry Research Institute of Nigeria (FRIN). The filter paper was moistened with 10 ml of distilled water and kept sufficiently moist at all times to supply the necessary moisture to the seeds. The seed lot from each provenance was subjected to two treatments (seeds in bright light and seeds in the dark). The seeds under light were subjected to daylight supplemented by four 60 w fluorescent tubes, while the seeds in the dark were placed under inverted glass funnels wrapped with a double layer of black polythene sheet. The treatments were observed daily for a month. The number of seeds that produced radicle and plumule was used as evidence of germination and was recorded each day.

Germination percentage of seeds from each provenance was determined according to Schelin *et al*.[20] as follows:

$$\text{Germination percentage}\left(\%\right)=\frac{\text{Total seeds germinated}}{\text{Total sseds sown}}$$

Descriptive statistics were used to present the data.

Effect of Light Intensity on Seedling Growth

The experiment was carried out at FRIN Central Nursery. River sand was washed and sterilized by heating in a clean drum for 1 h at 60°C. After cooling, it was filled into germination trays. One hundred seeds from each provenance were sown in germination trays filled with the washed and sterilized river sand. At two leaf stages, the seedlings were transplanted into 2 L capacity plastic pots using the standard potting mixture of the West African Hardwood Improvement Project (W.A.H.I.P) in FRIN. Light screening chambers with one layer, two layers, and three layers of 1 mm green plastic mesh net were constructed. The cages were made of 7.5 cm × 5 cm in thickness. The wooden frames were covered on all sides. One, two, or three layers were used to achieve varying level of light reduction. Frames covered with one layer of mesh net reduced light by 25%, two layers reduced light by 50%, while three layers reduced by 75%. Seedlings grown in the open received 100% light intensities.[1] The light intensities within and outside the cages were measured using a light meter model SOLEX SL 100 Lux Meter at 5 different days. Assessment of plant height, collar diameter, and leaf production was carried out fortnightly. Plant height (cm) measured with a meter rule; collar diameter (cm) was measured with a Vernier caliper; leaf produced per seedling was visually counted. Leaf areas (cm^2) were measured using portable leaf area meter model YMJ-B 1120578. Leaf, stem, and root biomass were also determined fortnightly for 12 weeks after transplanting. Data collected on dry weights and leaf areas were used to calculate relative growth rate (RGR), absolute growth rate (AGR), net assimilation rate (NAR), and shoot:root ratio.

The experimental design was 4 × 4 factorial with five replicates. Where the first factor was the four provenances and the second factor was different light intensities. The data collected were presented in tables, graphs and also subjected to analysis of variance. Means were separated by least significant difference LSD at 5% level of probability.

RESULTS

Seeds from Oluwa gave the highest germination with 88.0% followed by Oyo with 85.5%. This was closely followed by Aponmu seeds which attained 85.3%. Seed from Ibadan provenance had the lowest germination of 81.3% under light condition. The trend was, however, not observed for the dark condition in which case Aponmu seed attained 69.3% followed by Oyo and Ibadan seeds that had 64%. Seeds from Oluwa recorded the lowest germination 61.3% [Figure 1].

Effect of Varying Light Intensities on Seedling Growth

Table 1 shows that the highest mean value of height (33.3 cm) was observed under the treatment with 75% light intensity, while the lowest mean height (21.7 cm) was observed under the treatment with 25.0% light intensity. Seedlings from Oluwa provenance had the highest mean height of 15.1 cm while seedlings from Ibadan provenance had the lowest mean height of 12.8 cm. Highest mean height (28.5 cm) was observed at 12 weeks, the lowest mean height of 4.7 cm was observed at 2 weeks. The effects of light intensity and provenance on height growth of seedlings of *B. costatum* were significant different ($P < 0.05$).

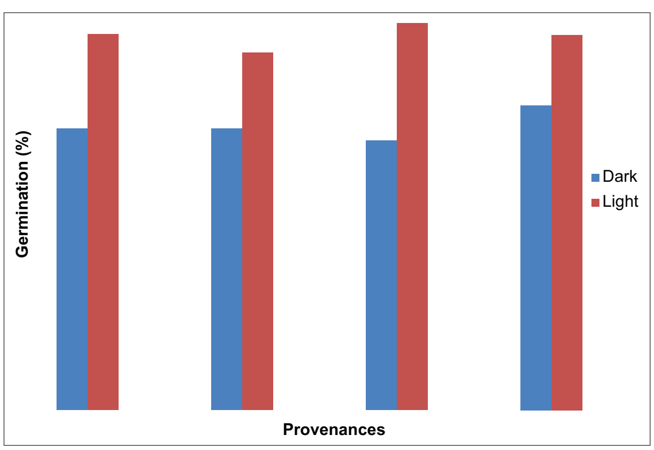

Figure 1: Percentage germination of *Bombax costatum* under light and dark conditions

The highest mean collar diameter (0.5 cm) was observed under the treatment with 75% and 100% light intensity, while the lowest mean diameter (0.3 cm) was observed for 25% light intensity [Table 1]. The highest mean diameter (0.5) was observed in Oyo, Aponmu, and Oluwa provenances, while the lowest mean value was observed in seedlings from Ibadan provenance. The highest mean collar diameter (0.8 cm) was recorded at 12 weeks while the lowest mean collar diameter (0.2 cm) was recorded at 2 weeks [Figure 2]. The effects of light intensity and provenances on collar diameter of seedlings of *B. costatum* were significant different ($P < 0.05$) [Table 1].

Table 1 shows that the highest mean number of leaves (7.2) was recorded under the treatment with 75% light intensity, while the lowest mean number of leaves 5.7 was recorded under the treatment with 25% light intensity. Seedlings from Ibadan provenance had the highest mean number of leaves (6.7), while Oyo and Oluwa seedlings produced the lowest mean number of leaves (6.5). Twelfth-week-old seedlings produced the highest mean number of leaves (9.8), while the lowest mean number of leaves (2.5) was observed at the 2nd week [Figure 2c]. There was increase in leaf production overtime among the provenances and light intensities. The effects of light intensity and provenances on leaf production of seedlings of *B. costatum* were significant different ($P < 0.05$) [Table 1].

The highest mean leaf area (138.4 cm^2) was observed under the 75% light intensity while the lowest mean leaf area of 112.3 cm^2 was observed under the 25% light intensity. The highest mean leaf area of 128.6 cm^2 was observed among

Table 1: Mean values of growth variables on seedlings of *Bombax costatum* under varying light intensities and provenances within 12 weeks of study

Main effects	Height (cm)	Diameter (cm)	Number of leaves	Leaf area (cm^2)
Light intensity (%)				
25	21.7a	0.3a	5.7a	112.3^a
50	23.5b	0.4a	6.5b	124.0^b
75	33.3c	0.5b	7.2c	138.4^c
100	24.5b	0.5b	6.9b	130.2^d
Least significant difference	0.47	0.01	0.23	2.51
Provenances				
Ibadan	12.8a	0.4a	6.7a	123.6^a
Oyo	13.6b	0.5b	6.5a	124.1^a
Aponmu	14.7c	0.5b	6.6a	128.6^b
Oluwa	15.1d	0.5b	6.5a	128.0^b
Least significant difference	0.47	0.01	0.12	2.51

Means with the same letter along a column are not significantly different from each other

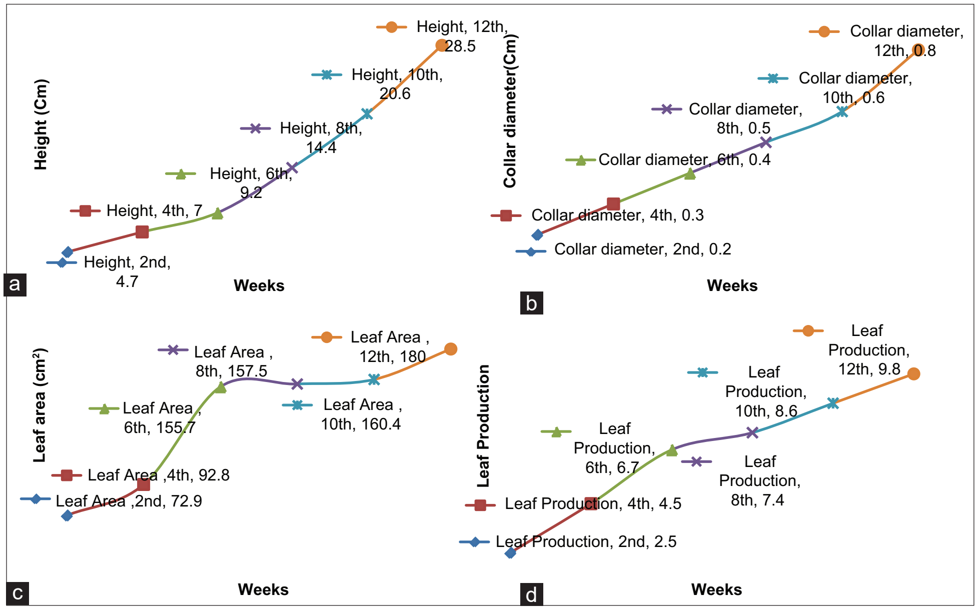

Figure 2: (a-d): Mean values of shoot height (a), collar diameter (b), leaf production (c), and leaf area (d) under varying light intensity within 12 weeks of study

seedlings from Aponmu provenance, while the lowest mean leaf area of 123.6 cm^2 was observed among seedlings from Ibadan [Table 1]. The highest mean leaf area 180.0 cm^2 was observe at the 12^{th} week while the lowest mean leaf area 72.9 cm^2 was observed at the 2^{nd} week [Figure 2]. The effects of light intensity and provenances on leaf area of seedlings of *B. costatum* were significant different ($P < 0.05$) [Table 1].

Seedlings from Aponmu subjected to 75% light intensity recorded the highest RGR 6.0×10^{-2} between the 10^{th} and 12^{th} weeks of assessment. The lowest value of 2.8×10^{-2} was observed under 25% light intensity between the 10^{th} and 12^{th} weeks. Seedlings from Oyo provenance exposed to 75% light intensity recorded the highest RGR of 6.9×10^{-2} between the 10^{th} and 12^{th} weeks while the lowest value of 2.9×10^{-2} was observed under 25% light intensity between the 10^{th} and 12^{th} weeks. The highest RGR of 5.3×10^{-2} was observed for seedlings from Ibadan under 75% light intensity between the 10^{th} and 12^{th} weeks. The lowest RGR of 2.4×10^{-2} was observed under 25% light intensity between the 10^{th} and 12^{th} weeks. It was observed that between the 10^{th} and 12^{th} weeks of assessment, seedlings from Oluwa under 75% light intensity attained the highest value of 5.0×10^{-2} between the 10^{th} and 12^{th} weeks while 25% light intensity recorded the lowest RGR of 2.2×10^{-2} between the 2^{nd} and 4^{th} weeks [Table 2].

Seedlings from Aponmu provenance recorded the highest AGR 6.5×10^{-1} under 75% light intensity between the 10^{th} and 12^{th} weeks, the lowest AGR 2.7×10^{-1} was recorded between the 8^{th} and 10^{th} weeks of assessment. Seedlings from Oyo provenance under 75% light intensity attained the highest AGR of 6.6×10^{-1} between the 10^{th} and 12^{th} weeks, the lowest value of 3.0×10^{-1} was observed under 100% light intensity between the 8^{th} and 10^{th} weeks. Seedlings from Ibadan provenance attained the highest value of 6.7×10^{-1} under 75% light intensity between the 10^{th} and 12^{th} weeks. The lowest AGR of 3.4×10^{-1} was recorded under 25% light intensity between the 10^{th} and 12^{th} weeks. The highest AGR 5.8×10^{-1} for seedlings from Oluwa provenance was attained at 75% light intensity between the 10^{th} and 12^{th} weeks while the lowest value of 3.1×10^{-1} was observed under 25% light intensity between the 10^{th} and 12^{th} weeks of assessment [Table 3].

Seedlings from Aponmu provenance obtained the highest value of NAR 6.0×10^{-3} under 75% light intensity between the 10^{th} and 12^{th} weeks. The lowest value of 2.7×10^{-3} was observed under 25% light intensity between the 10^{th} and 12^{th} weeks.

Seedlings from Oyo provenance subjected to 75% light intensity attained the highest NAR of 6.2×10^{-3} between the 10^{th} and 12^{th} weeks. The lowest NAR of 2.0×10^{-3} was observed under 25% light intensity between the 10^{th} and 12^{th} weeks of assessment. Seedlings from Ibadan provenance obtained the highest NAR of 6.1×10^{-3} under the 75% light intensity between the 10^{th} and 12^{th} weeks of assessment, while the lowest AGR of 2.2×10^{-3} was observed between the 10^{th} and 12^{th} weeks. Seedlings from Oluwa provenance subjected to 75% intensity attained the highest value for NAR 6.4×10^{-3} between the 10^{th} and 12^{th} weeks of assessment. The lowest value 2.1×10^{-3} was observed between the 6^{th} and 8^{th} weeks under 50% light intensity [Table 4].

Table 2: Relative growth rate (g/week) of *Bombax costatum* seedlings under varying light intensities and provenances within 12 weeks of study

Provenance	Light intensity	RGR_1	RGR_2	RGR_3	RGR_4	RGR_5
Aponmu	75	3.5×10^{-2}	3.0×10^{-2}	4.0×10^{-2}	5.8×10^{-2}	6.0×10^{-2}
	50	2.5×10^{-2}	3.5×10^{-2}	3.5×10^{-2}	3.0×10^{-2}	4.5×10^{-2}
	25	4.5×10^{-2}	3.5×10^{-2}	3.5×10^{-2}	3.5×10-2	2.8×10^{-2}
	100	2.5×10^{-2}	3.0×10^{-2}	2.7×10^{-2}	2.0×10^{-2}	3.1×10^{-2}
Oyo	75	3.3×10^{-2}	2.7×10^{-2}	3.2×10^{-2}	3.0×10^{-2}	6.9×10^{-2}
	50	4.5×10^{-2}	4.0×10^{-2}	3.0×10^{-2}	4.0×10^{-2}	3.2×10^{-2}
	25	3.6×10^{-2}	4.5×10^{-2}	4.0×10^{-2}	4.1×10^{-2}	2.9×10^{-2}
	100	6.0×10^{-2}	3.4×10^{-2}	3.0×10^{-2}	3.9×10^{-2}	3.4×10^{-2}
Ibadan	75	3.2×10^{-2}	4.2×10^{-2}	3.2×10^{-2}	3.7×10^{-2}	5.3×10^{-2}
	50	3.7×10	3.6×10^{-2}	3.3×10^{-2}	3.6×10^{-2}	3.4×10^{-2}
	25	2.9×10^{-2}	4.4×10^{-2}	3.1×10^{-2}	3.7×10^{-2}	2.4×10^{-2}
	100	4.7×10^{-2}	3.1×10^{-2}	4.8×10^{-2}	5.0×10^{-2}	4.4×10^{-2}
Oluwa	75	4.7×10^{-2}	4.3×10^{-2}	4.9×10^{-2}	4.9×10^{-2}	5.0×10^{-2}
	50	2.6×10^{-2}	3.7×10^{-2}	3.0×10^{-2}	3.0×10^{-2}	2.8×10^{-2}
	25	2.4×10^{-2}	2.8×10^{-2}	3.8×10^{-2}	2.9×10^{-2}	2.2×10^{-2}
	100	3.6×10^{-2}	3.3×10^{-2}	3.1×10^{-2}	3.5×10^{-2}	3.0×10^{-2}

RGR_1=RGR between the 2nd and 4th weeks, RGR_2=RGR between the 4th and 6th weeks, RGR_3=RGR between the 6th and 8th weeks, RGR_4 = RGR between the 8th and 10th weeks, RGR_5=RGR between the 10th and 12th weeks

Table 3: Absolute growth rate (g/week) of *Bombax costatum* seedlings under varying light intensities and provenances within 12 weeks of study

Provenance	Light intensity	AGR_1	AGR_2	AGR_3	AGR_4	AGR_5
Aponmu	75	4.5×10^{-1}	4.4×10^{-1}	3.7×10^{-1}	3.5×10^{-1}	6.5×10^{-1}
	50	4.0×10^{-1}	4.0×10^{-1}	4.0×10^{-1}	4.5×10^{-1}	6.0×10^{-1}
	25	4.5×10^{-1}	4.1×10^{-1}	3.8×10^{-1}	2.7×10^{-1}	3.5×10^{-1}
	100	3.0×10^{-1}	4.0×10^{-1}	4.0×10^{-1}	3.0×10^{-1}	4.5×10^{-1}
Oyo	75	4.0×10^{-1}	4.0×10^{-1}	4.5×10^{-1}	4.5×10^{-1}	6.6×10^{-1}
	50	4.5×10^{-1}	4.0×10^{-1}	5.0×10^{-1}	5.0×10^{-1}	4.0×10^{-1}
	25	3.6×10^{-1}	4.0×10^{-1}	4.0×10^{-1}	4.5×10^{-1}	3.4×10^{-1}
	100	5.6×10^{-1}	3.3×10^{-1}	4.5×10^{-1}	3.0×10^{-1}	4.0×10^{-1}
Ibadan	75	4.0×10^{-1}	5.0×10^{-1}	4.0×10^{-1}	5.0×10^{-1}	6.7×10^{-1}
	50	3.7×10^{-1}	3.6×10^{-1}	3.8×10^{-1}	4.5×10^{-1}	4.5×10^{-1}
	25	3.9×10^{-1}	3.9×10^{-1}	5.7×10^{-1}	3.6×10^{-1}	3.4×10^{-1}
	100	5.5×10^{-1}	3.6×10^{-1}	6.2×10^{-1}	5.4×10^{-1}	3.5×10^{-1}
Oluwa	75	3.6×10^{-1}	3.9×10^{-1}	4.6×10^{-1}	5.0×10^{-1}	5.8×10^{-1}
	50	3.4×10^{-1}	4.6×10^{-1}	3.4×10^{-1}	3.9×10^{-1}	4.1×10^{-1}
	25	4.6×10^{-1}	4.3×10^{-1}	3.3×10^{-1}	3.5×10^{-1}	3.1×10^{-1}
	100	3.3×10^{-1}	4.2×10^{-1}	4.3×10^{-1}	4.7×10^{-1}	4.8×10^{-1}

AGR_1=AGR between the 2nd and 4th weeks, AGR_2=AGR between the 4th and 6th weeks, AGR_3=AGR between the 6TH and 8th weeks, AGR_4=AGR between the 8th and 10th weeks, AGR_5=AGR between the 10th and 12th weeks

Seedlings from all the provenances had the highest shoot:root ratio of 6:1 under 75% light intensity at the 6th harvest. However, seedlings from Ibadan provenance had the lowest shoot:ratio of 3:1 under 25% light intensity at the 6th harvest [Table 5].

Table 4: Net assimilation rate (g/week/cm²) of *Bombax costatum* seedlings under varying light intensities and provenances within 12 weeks of study

Provenance	Light intensity	NAR_1	NAR_2	NAR_3	NAR_4	NAR_5
Aponmu	75	4.6×10^{-3}	3.5×10^{-3}	4.1×10^{-3}	5.1×10^{-3}	6.0×10^{-3}
	50	3.3×10^{-3}	4.0×10^{-3}	3.0×10^{-3}	2.9×10^{-3}	5.7×10^{-3}
	25	5.6×10^{-3}	4.6×10^{-3}	5.6×10^{-3}	2.9×10^{-3}	2.7×10^{-3}
	100	3.4×10^{-3}	3.8×10^{-3}	2.9×10^{-3}	4.4×10^{-3}	4.7×10^{-3}
Oyo	75	4.2×10^{-3}	3.6×10^{-3}	3.4×10^{-3}	4.5×10^{-3}	6.2×10^{-3}
	50	5.8×10^{-3}	3.6×10^{-3}	4.7×10^{-3}	5.0×10^{-3}	5.4×10^{-3}
	25	4.2×10^{-3}	4.5×10^{-3}	5.4×10^{-3}	4.5×10^{-3}	2.0×10^{-3}
	100	4.1×10^{-3}	2.7×10^{-3}	6.2×10^{-3}	3.0×10^{-3}	6.4×10^{-3}
Ibadan	75	4.0×10^{-3}	5.0×10^{-3}	3.3×10^{-3}	5.0×10^{-3}	6.1×10^{-3}
	50	4.6×10^{-3}	2.6×10^{-3}	3.5×10^{-3}	4.5×10^{-3}	5.3×10^{-3}
	25	5.7×10^{-3}	4.5×10^{-3}	2.9×10^{-3}	3.6×10^{-3}	2.2×10^{-3}
	100	6.1×10^{-3}	4.9×10^{-3}	5.4×10^{-3}	5.4×10^{-3}	5.2×10^{-3}
Oluwa	75	2.7×10^{-3}	2.7×10^{-3}	3.3×10^{-3}	5.0×10^{-3}	6.4×10^{-3}
	50	4.5×10^{-3}	2.8×10^{-3}	2.1×10^{-3}	3.9×10^{-3}	6.1×10^{-3}
	25	6.1×10^{-3}	2.6×10^{-3}	5.7×10^{-3}	3.5×10^{-3}	2.2×10^{-3}
	100	2.3×10^{-3}	3.2×10^{-3}	4.1×10^{-3}	4.7×10^{-3}	5.6×10^{-3}

NAR_1=NAR between the 2nd and 4th weeks, NAR_2=NAR between the 4th and 6th weeks, NAR_3=NAR between the 6th and 8th weeks, NAR_4=NAR between the 8th and 10th weeks, NAR_5=NAR between the 10th and 12th weeks

Table 5: Shoot:root ratios of *Bombax costatum* seedlings under varying light intensities and provenances within 12 weeks of study

Provenance	Light intensity	H1	H2	H3	H4	H5	H6
Aponmu	75	5:1	4:1	4:1	4:1	4:1	6:1
	50	4:1	4:1	4:1	4:1	4:1	4:1
	25	5:1	4:1	5:1	4:1	4:1	3:1
	100	4:1	4:1	4:1	4:1	4:1	5:1
Oyo	75	4:1	5:1	4:1	4:1	4:1	6:1
	50	4:1	4:1	4:1	4:1	4:1	4:1
	25	4:1	4:1	5:1	4:1	4:1	3:1
	100	4:1	4:1	4:1	4:1	4:1	4:1
Ibadan	75	4:1	4:1	4:1	4:1	4:1	6:1
	50	5:1	5:1	4:1	4:1	4:1	4:1
	25	5:1	5:1	5:1	4:1	4:1	3:1
	100	4:1	4:1	4:1	4:1	4:1	4:1
Oluwa	75	4:1	4:1	4:1	4:1	4:1	6:1
	50	4:1	4:1	4:1	5:1	5:1	4:1
	25	5:1	5:1	5:1	4:1	4:1	4:1
	100	4:1	4:1	4:1	4:1	4:1	4:1

H_1=1st harvest, H_2=2nd harvest, H_3=3rd harvest, H_4=4th harvest, H_5=5th harvest, H_6=6th harvest

DISCUSSION

The significant effect of light observed on the germination *B. costatum* seeds shows that it requires light to germinate and said to be positive photoblastic.[7] Positive photoblastism is one of the physiological characteristics that could favor the formation of seed bank in the soil.[21] Oyedeji *et al*.[22] reported that there was no significant difference between the germination percentages of *Dialium guineense* planted under both light and dark media; although higher percentage was recorded for the seeds exposed to light. The effect of light on the germination of *B. costatum* seeds was observed to be non-significant based on the provenances. However, Fenner and Thompson [3] and Flores *et al*.[23] reported that specific light requirements for germination of many species are complex and can be varied with season and habitat. In addition, Oyedeji *et al*.[22] identified some tree species that their seeds germination is suppressed or inhibit by light. Such tree species include *Cecropia obtusifolia* and *Cirsium pitcheri*.

The varying number of leaves produced by *B. costatum* as a result of varying light intensity is similar to the findings of Islam *et al*.[24] that number of leaves of *Cattleya* varied between 4.83 and 7.30 for different colors of light. The significant difference on the effect of varying light intensity on the germinated *B. costatum* features across the provenances except on the number of leaves is in agreement with the report of Simão and Takaki[4] that the specific requirement for seed germination can be associated to the life form of each species, the environment where the plant will be established and also the geographic distribution. More so, the light requirement for seed germination also depends on the seed characteristics, development, and maturation conditions of the seed as well as size of the seeds.[25-30]

Light requirement of seed germination differs in intensities, qualities, colors, and duration among different tree species.[16,31,32] It can also vary with temperature.[33] This is in agreement with the report of Maloof *et al*.[34] that many species respond to the environment with optimal growth and development according to the light they receive. However, variation of light intensity and period of light exposure have no effect on the seeds germination of some tree species. They germinate similarly in light and darkness.[35] It was observed that seed sown at 75% light intensity germinate and grew best among the treatment. However, the germination rates and growth of seeds sown at 100% light intensity were not significantly different from the lower intensities. This observation is consistent with the report of Veloso *et al*.[13] that seeds sown under high light intensity had a lower germination percentage than seeds sown under low light intensity. Likewise, Onyekwelu *et al*.[36] reported that the overall best growth and most stable seedlings of *Chrysophyllum albidum* were obtained under 40% light intensity. They emphasized that such species needs shading during their early growth because if such seedlings are exposed to 100% light intensity and open sky; they may die shortly after emergence. However, some species like *Irvingia gabonensis* seedlings could survive if planted in open field, without shading.[36]

CONCLUSION

The effect of light on the germination of *B. costatum* seeds and influence of different light intensities on the seedlings of *B. costatum* were assessed. *B. costatum* seeds were identified to be positive photoblastic with highest germination percentage in the light condition. The variations on the germination percentage by the effect of light of *B. costatum* seeds from different provenances were found to be insignificant. The growth of *B. costatum* seedlings was mostly enhanced at 75% light intensity in comparison to others. Therefore, for optimum germination of *B. costatum* seeds and seedlings growth, there must be provision of sufficient light.

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