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EFFECTS OF SOURCES OF NITROGEN AND WATERING REGIMES ON THE GROWTH OF AFRICAN STAR APPLE (*Chrysophyllum albidum* G. Don) SEEDLINGS

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Abstract

There is paucity of researched established information on the effect nitrogen-based fertilizers on the growth of Chrysophyllum albidum. To improve the slow growth of Chrysophyllum albidum, investigation was carried out. A 3 x 3 split-plot experimental design accompanying three replications was selected to determine the effects of sources of nitrogen and watering regimes on the growth of Chrysophyllum albidum seedlings. Three sources of nutrient namely, urea (5g)., calcium ammonium nitrate (5g) (CAN) and cow dung (10g) constituted the main plot treatment. The daily watering (200ml), 3 days interval (200ml) and 5 days interval (200ml) constituted sub plot treatment. The treatment consisted of three sources of nitrogen and three watering regimes copied three times. Twelve (12) seedlings represented a replicate. Three hundred and twenty-four (324) seedlings were involved. A month old C. albidum seedlings were transplanted into pots with and without fertilizers and subjected to 200ml at varying day's interval. Data collected were subjected to two-way Analysis of Variance (ANOVA) at 5% level of significance. The results revealed that sources of nitrogen and watering regimes considerably (p<0.05) embellished the growth of C. albidum. Among the sources of nitrogen, seedlings cultivated in soil influenced with urea had significant height (24.38cm)., girth (3.42cm)., collar diameter(1.71cm)., relative turgidity (68.91%)., NAR(0.007gcm^{-2}wk^{-1}) and AGR (0.703gwk^{-1}). Significant height (28.67cm)., girth(3.8cm)., leaf number (18.82)., collar diameter (1.90cm) and RGR (0.80gg^{-1}wk^{-1}) were recorded from seedlings subjected to 3 days watering intervals. The amendment of soil with urea and administration of 3 days watering intervals enhances the growth of C. albidum seedlings.

Key Words: *Sources of nitrogen, Watering regime, Growth, Soil amendment, Inorganic fertilizers*

Introduction

Forests are one of the most vital ecosystems on earth and origin of many sources of food, raw materials for construction, water, energy and wild plants domesticated into alarmingly chief crops (Nosiru *et al.,* 2017) and basis of plant derived medicines and bioactive compounds that promote health (KrisEtherton *et al.,* 2002; Moutsatsou, 2007). The tropical forests have been the origin of useful timber (Onyekwelu *et al.,* 2007) and non-timber species, donating to the ecological importance, construction works, building, furniture items and bridges (Fuwape, 2000) as well as social and economic growth of the rural dwellers in many countries (Iroko *et al.,* 2020). There is consistent and unabated exploitation of these timbers species through deforestation to meet human demands for forest products as well as their needs for economic development. This activity destroys the genetic bases of tropical trees; including those fundamental for survival of present and future generation (Leakey, 1998) as *Chrysophyllum albidum.*

Chrysophyllum albidum is a variety of climax tree, found in tropical rainforest and belongs to the family Sapotaceae (Olaoluwa *et al.,* 2012; Wole, 2013) that produce closely half of the order with 800 species (Ehiagbonare *et al.,* 2008). It is called "Osan Agbalumo," "Udara" or "Udala" and "Agwaluma or Agwaluba" in Yoruba, Igbo and Hausa languages respectively (Rahaman, 2012; Wole, 2013; Adelani *et al.,* 2018). The immense economical (Onyekwelu *et al.,* 2011); nutritional and medicinal (Adisa, 2000; Burits and Bucar, 2002; Onyekwelu and Stimm, 2011; Wahab and Osikabor, 2017), industrial (Olaoluwa *et al.,* 2012)., ecological (Aduradola *et al.,* 2005) and fire wood and timber (Wahab and Osikabor, 2017) values of *C. albidum* have been published. It is among the forest tree species which is incorporated in the traditional agroforestry system (Ureigho and Ekeke, 2010; Laurent *et al.,* 2012) that provides Non Timber Forest Products, NTFPs of huge household significance to rural and urban dwellers in West Africa, with great export prospects (Nwoboshi, 2000). The eating of the fruits of *C. albidum* preventing diabetes and cancer, help to lower blood sugar as well as cholesterol level which eventually assist to prevent heart diseases (Burits and Bucar, 2002).

In spite of huge potentials of *C. albidum,* it has been considerably ignored specifically concerning its regeneration (Adelani *et al.,* 2016; Adelani *et al.,* 2017) and its propagation has been limited owing to slow growth (Adelani and Muhammed, 2017; Adelani, 2023). Oni and Ojo (2002) established that the growth of many native timber and fruit tree species in the tropics is slow despite exposure to normal edaphic and environmental condition. The slow growth of *C. albidum* and poor soil fertility that associate with deforestation as well as degradation are challenges to its regeneration and conservation. The deforestation of natural forest resources has subjected the soil to wind and water deterioration as well as other factors that cause decline in soil minerals (Adelani, 2023). Dania *et al.* (2014) noticed that the major limiting factor of crop production in the tropics is the inadequacy of soil nutrient resulting from land degradation which affects the growth, nutrient content, and uptake of the plant. Tropical soils and forests are insufficient in nitrogen and phosphorus nutrients and uptake of these limited quantities of nutrients by plant roots from litter (Jose, 2003) is affected by many other factors. Deficiencies of soil nutrients need adequate management. Inadequate management of nursery soil can result in exhaustion of soil fertility and a corresponding reduction in seedling growth (Hoque *et al.,* 2004).

To overcome challenges of poor soil fertility and slow growth of *C. albidum* seedlings, adequate management through fertilizer application is the reasonable alternative for it to meet state population demands of its potentials. Adequate application of synthetic fertilizer is preferred to organic fertilizer. Recently, farmers tend to use chemical fertilizers individually for appropriating the needs of plant nutrient elements. Due to the fact that they are more affordable, easy to use and quick in response; while, organic fertilizer performed slower response on crop yield, even though they are good in maintaining soil properties (Purbajanti *et al.,* 2019). Anisuzzaman *et al.* (2021) stated that chemical fertilizers provide nutrients that are easily soluble in soil solutions and hence available to plants almost immediately. The application of man-made fertilizers is commonly regarded as the most dynamic method to improve soil fertility and crop productivity (Chen *et al.,* 2017). Makinde *et al.* (2007) established that the mineral fertilizers rapidly perform better than organic manure.

Application of inorganic fertilizer to seedlings helps to produce quality planting stocks. Hoque *et al.* (2004) reported that sustaining of sufficient fertility of nursery soil is important to assure production of high quality planting stock. High quality planting stocks will have better adaptation, resistance to environmental stress and a better field performance over long term (Davis and Jacobs, 2005). Not only to fertilize *C. albidum* seedlings is important, but also to subject it to appropriate watering regime that enhances its growth for quality planting stock. Adequate fertilizer application and watering regimes are important determinants and prominent among factors that influence production and growth of quality young plant. There are four main basic determinants that influence plant growth and development namely; light, water, temperature and nutrients (Lehmann *et al.,* 2006) and plant respond to them differently. Hoque *et al.* (2004) stated that nutrient and environmental situations vary among species. The amount of these factors requires vary from species to species. Plants response to nutrients and water also vary.

Growth and biomass result is straight forwardly equivalent to the supply and use of water in plant (Cao, 2000, Olajuyigbe *et al.,* 2013). Soil water is a key parameter in seedling survival and growth because of sensitivity of photosynthesis to water availability. Water stress hinders photosynthesis through stomatal and non-stomatal effect (De Costa and Rozana, 2000). In order to ascertain the growth of plant to meet population demand of its ample potentials, fertilizer requirement and watering regime need to be investigated to avoid wastage of time, energy and fertilizer. There is scarcity of quantified information on the effect of sources of nitrogen and watering regimes on the growth of *Chrysophyllum albidum* seedlings. In this light, investigation was conducted into the effect of sources of nitrogen and watering regimes on the early growth of *C. albidum* seedlings with a view to improve its growth.

Materials and Method

Description of Experimental Site

The experimental site was at the forest nursery of the Federal University of Agriculture, Abeokuta. It is situated along Alabata Road, North-East of Abeokuta. It is located within latitudes 7 ^{o}N and 7 ^{o}55 ' N and longitudes 3 ^{o} 20 'E and 3 ^{o} 37 ' E. The Federal University of Agriculture, Abeokuta is situated inside the rain forest zone of Southwestern Nigeria (Amujoyegbe *et al.,* 2008). It is next to Ogun-Osun River Basin Development Authority (OORBDA), along Osiele-Abeokuta road, off Abeokuta-Ibadan road. It is in the Northeastern end of Abeokuta and lies nearly on latitude 7^{o} 30 ' N and longitude 3^{o} 54 ' E. It positions within the humid lowland rain forest region with two distinctive seasons. The wet season extends from March to October while the dry season extends from November to February (Aiboni, 2001). The rainfall has a characteristic bimodal distribution with peaks in July and September and breaks in August. Generally, the rainfall could be heavy and erosive sometimes accompanied by lightning and thunderstorm at the beginning and end of rainy season.

Experimental Design

The effect of sources of nitrogen and watering regimes on the growth of *Chrysophyllum albidum* seedling was studied. A 3x3 split-plot experimental design accompanying three replications was adopted to assess the effect of sources of nitrogen and watering regimes on the growth of *Chrysophyllum albidum* seedlings. Three sources of nutrient namely, urea (5g), calcium ammonium nitrate (CAN) (5g) and cow dung (10g) constituted the main plot treatment. The daily watering (200ml), 3 day interval (200ml) and 5 days interval (200ml) constituted sub plot treatment. The treatment consisted of three sources of nitrogen and three watering regimes replicated three times. Twelve (12) seedlings represented a replicate. The uniform sizes of three hundred and twenty four (324) seedlings raised from seeds were involved. The seedlings of *C. albidum* of uniform size at 4-6 leaf stages were transplanted into 0.75 litre polypots that contained acid washed sand with and without fertilizers and subjected to vary watering regimes.

After two weeks of seedling establishment, growth variables were taken fortnightly for 6 months. Growth parameters studied include; Seedling height with the use of meter rule; girth with the use of venier caliper; collar diameter was determine by meter rule., the number of leaves were counted manually and Leaf area was obtained by linear measurement of leaf length and leaf width as described by Clifton-Brown and Lewandowski (2000).

$$LA=0.74xLxW \qquad (1)$$

Where, LA =Leaf area is the product of linear dimension of the length and width at the broadest part of the leaf. The mean of the growth changeable for period of experiment was used for tabulation. Total fresh weight (TFW), total dry weight (TDW), relative turgidity (RT), net assimilation rate (NAR), absolute growth rate (AGR), relative growth rate (RGR), chlorophyll a, b and a+b and nitrogen uptake were determined during and after 24 weeks.

Absolute Growth Rate

$$AGR = \frac{W2-W1}{T2-T1} gwk^{-1} \quad (2)$$

W_2 and W_1 are plant weight at corresponding time T_1 and T_2.

Relative Growth Rate

RGR=LAR*NAR

LAR=Leaf Area Ratio

$$RG\ R = \frac{\log e\ W2-\log e\ W1}{T2-T1} gg^{-1}\ wk^{-1} \quad (3)$$

T_1=Initial time (Weeks)

T_2= Final or second time (Weeks)

W_2= Total dry weight at T_2

W_1=Total dry weight at T_1

Net Assimilation Rate

$$NAR=\frac{w2-w1}{t2-t1} \times \frac{\log e\ A2-\log eA1}{A2-A1} gcm^{-2}wk^{-1} \quad (4)$$

Where W_2 and W_1 are plant dry weights at times t_1 and t_2, $\log_e A_2$ and $\log_e A_1$ are the natural logs of leaf areas A_1 and A_2 at times t_1 and t_2.

Relative Turgidity

Relative turgidity also known as relative water content was considered by difference between fresh weight and dry weight divided by turgid weight minus dry weight multiply by 100. Turgid weight was determined by weight of the plant before and after soaking in water for 24 hours. Seedling of high vigour was divided into three parts namely; leaf, stem and root. Each part was weighed (fresh weight, FW), then left saturated in purified water for twenty four (24hrs) (under normal room light and temperature) (Turgid Weight) and after hydration, the samples were then dried in an oven at 70ºC for 48 hours and weighed (DW) (after being cool down in desiccators).

The RWC/RT is determined as follows:

$$\text{Relative turgidity}=\frac{Fw-Dw}{Tw-Dw} \times 100 \quad (5)$$

FW= Fresh weight

DW= Dry weight

TW= Turgid weight

Measurements of Chlorophyll

Seedling of extreme vigour was detached into three parts namely; leaf, stem and root and grinded with mortar and pestle. Thereafter, 20 ml of 80% acetone and 0.5 g of ($MgCo_3$) powder was added and further grinded gently. Measurements of chlorophyll concentration were made by direct determinations of the absorbance at different wavelengths, using Model 6405 uv/vis Spectrophotometer, serial number 1364. The reading was taken in a triplex sample and mean was considered for computation of chlorophyll content such as the chlorophyll a, b and a + b (total chlorophyll). The concentrations were calculated by adding 20.2 A645, 8.02 A 663 multiplied by the volume of chlorophyll solution in mL, divided by length of light path in cell (usually 1cm), fresh weight in grams and 1000. A645 and A663 is the absorbance at 645 and 663 nm.

Chlorophyll a (mgg^{-1}) =12.7(A663) - 2.69(A645) x VC/LLP x FW x 1000

$$= \frac{12.7(A663)-2.69(A645)xVC}{LLPxFWx1000} \quad (6)$$

Chlorophyll b (mgg^{-1}) =22.9(A645)-4.86(A663) x VC/ LLP x FW x1000

$$= \frac{22.9(A645)-4.86(A663)\ xVC}{LLPxFWx1000} \quad (7)$$

Total Chlorophyll a+b (mgg^{-1}) = (20.2(A645) + 8.02(A663) x VC/LLP x FW x 1000

$$= \frac{20.2\ A645 + 8.02\ A663\ xVC}{LLPxFWx1000} \quad (8)$$

Where A= absorbance at the given wavelength
C.C= Concentration of Chlorophylls
VC= Volume of chlorophyll in mL
LLP= Length of light path usually 1cm
FW= Fresh Weight in grams

Nutrient Uptake

Tissue analysis was estimated for the sample of leaf, stem and root of whole plant of *C. albidum* seedlings before transplanting in the beginning and after transplanting at end of the experiment respectively to determine nutrient uptake. The nitrogen, phosphorus and potassium content were determined by Macro Kjeldahi method, Bray-1 method and flame photometry method respectively.

Nutrient Uptake was evaluated by Method of Sharma *et al.* (2012) $\frac{\%N \times \%P \times \%K \times Dry\ matter\ kg\ ha-1}{100}$ (9)

Actual nutrient uptake was determined by changes in nutrient uptake at the beginning and the end of the experiment.

Data Analysis

Data were collected and subjected to analysis of variance (ANOVA) using SAS (2003). A comparison of significant means was accomplished using Fishers' Least Difference LSD at 5% level of significance.

Results

Effects of Sources of Nitrogen and Watering Regimes on the Growth of C. albidum Seedlings

Among the sources of nitrogen, seedlings planted in soil influenced with urea had significant height (24.38cm)., girth (3.42cm)., collar diameter(1.71cm)., relative turgidity (68.91%)., NAR($0.007gcm^{-2}wk^{-1}$) and AGR ($0.703gwk^{-1}$). Seedlings cultivated in the soil enhanced with CAN gave significant leaf number (16.37)., leaf area ($152.24cm^2$)., total fresh weight (9.51g) and total dry weight (3.99g). The least values of girth (2.46cm)., collar diameter (1.23cm)., total fresh weight (5.88g)., total dry weight (2.19g)., relative turgidity (62.12%)., NAR ($0.004gcm^{-2}wk^{-1}$) and AGR ($0.342gwk^{-1}$) were written from seedlings planted in soil improved with cow dung. Significant height (28.67cm)., girth (3.8cm)., leaf number (18.82)., collar diameter (1.90cm) and RGR ($0.80gg^{-1}wk^{-1}$) were recorded from seedlings subjected to 3 days watering intervals. Seedlings watered at 5 days watering interval produced highest values of TFW (8.78g)., TDW (3.96g)., NAR ($0.006\ gcm^{-2}\ wk^{-1}$) and AGR ($0.736\ g\ wk^{-1}$) (Table 1).

Table 1: Effects of Sources of Nitrogen and Watering Regimes on the Growth of *C. albidum* Seedlings

S.N	Ht (cm)	G (cm)	LN	LA (cm^2)	CD (cm)	TFW (g)	TDW (g)	R.T %	NARgcm^{-2}wk^{-1}	AGR(g wk^{-1})	RGR(gg^{-1}wk^{-1})
Urea	24.38^{a}	3.42^{a}	12.21^{b}	103.34^{b}	1.71^{a}	8.22^{ab}	3.94^{a}	68.91^{a}	0.007^{a}	0.703^{a}	0.424^{b}
CAN	15.63^{b}	2.80^{b}	16.37^{a}	152.24^{a}	1.40^{b}	9.51^{a}	3.99^{a}	66.05^{a}	0.004^{b}	0.627^{a}	0.456^{b}
CDG	23.46^{a}	2.46^{c}	13.97^{b}	105.84^{b}	1.23^{c}	5.88^{b}	2.19^{b}	62.12^{a}	0.004^{b}	0.342^{b}	1.135^{a}
SE±	1.36	0.13	0.76	6.43	0.06	0.60	0.32	3.17	0.001	0.070	0.03
WR											
1	13.76^{c}	2.38^{b}	10.31^{c}	154.27^{a}	1.17^{b}	8.55^{b}	3.41^{ab}	74.00^{a}	0.0105^{a}	0.523^{ab}	0.442^{c}
3	28.67^{a}	3.80^{a}	18.82^{a}	93.08^{c}	1.90^{a}	6.28^{b}	2.76^{b}	61.15^{b}	0.005^{a}	0.414^{b}	0.800^{a}
5	21.03^{b}	2.53^{b}	13.41^{b}	114.06^{b}	1.26^{b}	8.78^{a}	3.96^{a}	61.92^{b}	0.006^{a}	0.736^{a}	0.528^{b}
SE±	1.36	0.13	0.76	6.43	0.06	0.60	0.32	3.17	0.001	0.10	0.03

Means on the same column having different superscripts are significantly different ($p<0.05$)
Ht= Height, G=Girth, LN= Leaf Number, LA= Leaf area, TFW=Total Fresh Weight, TDW=Total Dry Weight, R.T= Relative Turgidity, NAR= Net Assimilation Rate, Absolute Growth Rate = AGR, RGR= Relative Growth Rate, WR=Watering Regime

Interactive Effect of Sources of Nitrogen and Watering Regimes on the Growth of C. albidum Seedlings

Significant girth (5.08cm)., leaf number (23.06) and collar diameter (2.54cm) were written from seedlings cultivated in the soil with CAN and subjected to 3 days watering interval. Significant TFW (12.25g)., TDW (5.95g) and AGR (1.091 gwk^{-1}) were recorded from seedlings planted in the soil enhanced with CAN and subjected to 5 days watering interval. The least values of girth (1.62cm)., leaf area (18.83cm^2)., collar diameter (0.81cm)., TFW (4.2g)., TDW (1.45g)., relative turgidity (43.37%) and AGR (0.245 gwk^{-1}) were recorded from seedlings planted in cow dung and subjected to five days watering regimes. Generally, watering at 3 days interval produced seedlings with superior morphological parameters, while watering at 5 days enhanced physiological parameters (NAR, AGR and RGR).

Table 2: Interactive Effect of Sources of Nitrogen and Watering Regimes on the Growth of *C. albidum* Seedlings

SN	WR	Ht (cm)	G (cm)	LN	LA (cm^2)	CD (cm)	TFW (g)	TDW (g)	RT(%)	NAR($gcm^{-2}wk^{-1}$)	AGR (gwk^{-1}	RGR ($gg^{-1}wk^{-1}$)
Urea	1	11.25^{d}	2.07^{de}	7.28^{d}	70.72^{c}	1.03^{de}	8.43^{b}	4.08^{ab}	72.89^{ab}	0.008^{a}	0.691^{b}	0.406^{b}
Urea	3	36.42^{a}	3.94^{bc}	18.74^{b}	56.33^{c}	1.97^{bc}	6.33^{bc}	3.28^{b}	63.09^{b}	0.007^{a}	0.545^{bc}	0.461^{b}
Urea	5	25.46^{bc}	4.26^{b}	10.54^{d}	182.9^{b}	2.13^{b}	9.90^{ab}	4.48^{ab}	70.74^{ab}	0.006^{a}	0.873^{ab}	0.405^{b}
CAN	1	10.35^{d}	1.63^{e}	10.05^{d}	176.69^{bc}	0.81^{e}	8.83^{ab}	3.13^{b}	63.70^{b}	0.003^{a}	0.373^{bc}	0.448^{b}
CAN	3	26.56^{b}	5.08^{a}	23.06^{a}	145.64^{c}	2.54^{a}	7.45^{bc}	2.90^{b}	62.80^{b}	0.003^{a}	0.418^{bc}	0.432^{b}
CAN	5	9.97^{d}	1.70^{e}	16.00^{bc}	140.39^{c}	0.85^{e}	12.25^{a}	5.95^{a}	71.66^{ab}	0.006^{a}	1.091^{a}	0.488^{b}
CDG	1	19.69^{c}	3.35^{c}	13.61^{cd}	221.41^{a}	1.68^{c}	8.40^{b}	3.03^{b}	85.43^{a}	0.003^{a}	0.505^{bc}	0.471^{b}
CDG	3	23.04^{bc}	2.39^{d}	14.65^{c}	77.27^{c}	1.20^{d}	5.05^{bc}	2.10^{b}	57.56^{bc}	0.004^{a}	0.277^{c}	0.540^{ab}
CDG	5	27.67^{b}	1.62^{e}	20.49^{ab}	18.83^{d}	0.81^{e}	4.20^{c}	1.45^{b}	43.37^{c}	0.006^{a}	0.245^{c}	0.692^{a}
SE±		2.55	0.27	1.63	12.72	0.14	1.45	0.78	7.70	1.98	0.15	0.07

Means on the same column having different superscript are significantly different ($p<0.05$)

Ht= Height, G=Girth, LN= Leaf Number, LA= Leaf area, TFW=Total Fresh Weight, TDW=Total Dry Weight, R.T= Relative Turgidity, NAR= Net Assimilation Rate, Absolute Growth Rate = AGR, RGR= Relative Growth Rate, WR=Watering Regime

Effects of Sources of Nitrogen and Watering Regimes on the Chlorophyll and Nitrogen Uptake of C. albidum Seedlings

Highest value of chlorophyll a (0.2202 mg/g) and chlorophyll b (0.2282 mg/g) were written from seedlings cultivated in the soil improved accompanying cow dung. Highest value of total chlorophyll (a+b) (0.4313 mg/g) and total N uptake (3.96 %) were recorded from leaf of seedlings cultivated in the soil improved accompanying urea. With exception of stem of seedlings planted in cow dung, all chlorophyll increased from leaf to root. It was observed that N-uptake was highest in the leaves and least in the root (Table 3).

Table 3: Effect of Sources of Nitrogen and Watering Regimes on the Chlorophyll and Nitrogen Uptake of *C. albidum* Seedlings

S/N	PLTP	Chllph a	Chllph b	Chllph a+b	N% uptake
Urea	Leaf	0.2178^{a}	0.2116^{ab}	0.4313^{a}	3.96^{a}
	Stem	0.0897^{b}	0.0910^{ab}	0.1820^{c}	2.91^{ab}
	Root	0.0303^{c}	0.0672^{b}	0.0574^{d}	1.81^{ab}
CAN	Leaf	0.1978^{a}	0.1574^{ab}	0.3552^{b}	3.83^{a}
	Stem	0.0813^{b}	0.0739^{b}	0.1551^{cd}	2.09^{ab}
	Root	0.0266^{c}	0.0557^{b}	0.0505^{d}	2.60^{ab}
CDG	Leaf	0.2202^{a}	0.2282^{a}	0.1719^{cd}	2.43^{ab}
	Stem	0.0935^{b}	0.2191^{ab}	0.1732^{cd}	0.82^{b}
	Root	0.0745^{bc}	0.0308^{b}	0.0542^{d}	1.23^{ab}
SE±		0.02	0.06	0.02	1.12

Means on the same column having different superscript are significantly different ($p<0.05$)
PLT=Plant, Chllph= Chlorophyll, N = Nitrogen

Discussion

Highest values of growth parameters recorded from seedlings cultivated in soil modified with urea revealed its superior among the sources investigated irrespective of watering regime. Urea embellishes the growth of *C. albidum* seedlings. Similar remark has been fashioned by Iroko *et al.* (2020) who suggested fertilization at 0.09gN/pot (141kg/ha) urea for raising *Pterocarpus erinaceous* seedlings. The application of 1g of urea fertilizer was advocated for raising *Blighia sapida* seedlings (Adedokun *et al.,* 2020). For optimal production of *Sterculia setigera* in the nursery, 0.20g of NPK., 0.66kg of urea and daily watering regime were approved (Aiyeloja and Azeez, 2010). It could be inferred that urea is the suitable sources of nitrogen compared to other investigated sources. Sources of nitrogen increase the growth performances of the seedlings. Various investigators as Hamson *et al.* (2002) (conifers)., Warren and Adams (2002) (*Pinus pinaster*)., Garbin and Dillenburg (2008) (*Araucaria augustifolia*)., Khamis *et al.* (2013) (*Populus euphratica*) and Adelani *et al.* (2020a) (*Chrysophyllum albidum*) have reported the efficacy of sources of nitrogen in embellishing the growth of plants.

The outstanding growth variables written from seedlings cultivated in urea is identifiable to its highest nitrogen uptake and total chlorophyll relative to other investigated species. Nitrogen uptake revealed the amount of nitrogen utilized by the plant for successful growth. Nitrogen is an essential element for the plant growth. Nitrogen is an element of many plant cell components, including amino and nucleic acid (Hu and Schmidhalter, 2005). Nitrogen is part of numerous enzymatic proteins that catalyses and regulate plant-growth process (Sinfield *et al.,* 2010). Nitrogen has been called the growth element because it is an important part of plant protoplasm. Protoplasm is the seat of cell division (Abod and Siddiqui, 2002). Haggai *et al.* (2003) established that the rate of growth of most plant is almost equivalent to the amount of nitrogen delivered by the soil. Nitrogen is often the most restricting mineral element in plant and crucial constituent of chlorophyll (Li, 2000; Anderson, 2015). Nitrogen donates to the production of chemical components that protect against parasites and plant diseases (Hoffland *et al.,* 2000). On the other hand, black spruce survival was adversely overwhelmed by over fertilization of sources of nitrogen (Bussieres *et al.,* 2008). Oskarsson and Sigurgeirsson (2001) again noticed that the survival of locally manured trees declined when sources of nitrogen fertilizer levels were too high.

The least growth variables were written from seedlings cultivated in soil improved with cow dung. However, several researchers reported the contrary findings. Babalola *et al.* (2000) established that the common organic fertilizer in Nigeria today (cow dung) has such macro nutrients N, P, K and Mg which are needed for early plant growth and development. In the same consonance, Ugwu *et al.* (2010) endorsed 60kg/ha of cow dung for magnificent performance of *Treculia africana* seedlings. Idowu *et al.* (2014) stated that cow dung is the most appropriate manure for *Treculia africana* seedlings in terms of mineralization and it is partially rapid when compared with poultry manure. For getting optimum leaf biomass yield of *Stevia rebaudiana* along with fertility of both soils, cow dung should be activated at 10 t ha^{-1} (Zaman *et al.,* 2017). Ahmed *et al.* (2022) approved 10 t ha^{-1} of cow dung for planting of *Raphanus sativus*. The application of cow manure stimulated root production of *Prunus persica* (Baldi and Toselli, 2013). Dachung and Kalu, (2019) commended cow dung for optimal growth of *Tamarindus indica* seedlings. Agbo-Adediran and Osho (2019) expressed that 10g of cowdung+ 2kg of topsoil should be employed to raise *Entandrophragma angolense*.

Highest values of growth specifications recorded from seedlings watered at 3 days interval demonstrated that moderate watering days is essential for the growth of *C. albidum* seedlings. Modest watering prevents the scarcity and excess supply of water. Three days interval makes the soil not to be too wet or dry for nitrogen sources to release its nitrogen. Similar conclusion has been reported by Smith (2014) who announced that nitrogen in the soil is not available to the plants when the soil is wet and cold. Watering interval of three days would not subject *Dialium guineense* seedlings to water-stress (Olajide *et al.,* 2014). Isah *et al.* (2012) announced that the result stipulated that Yobe and Borno provenance of *Acacia senegalensis* produced better when watered once in three days. *Measobotrya barteri* performed well when cultivated in topsoil and watered once in 3 days (Ezenwankwo *et al.,* 2020). Adesope *et al.* (2006) affirmed that *Parkia biglobosa* seedlings subjected to watering once in three days had the best growth production. Contrary to the result of this finding, Aderounmu *et al.* (2017) nominated watering once in five (5) days for the optimal growth of *Terminalia superba* in the nursery. Optimum performance was achieved under 50ml of water twice per week, while raising *Vitellaria paradoxa* seedlings in the nursery (Aderounmu and Adegeye, 2011).

It could also be concluded that moderate watering influences plant growth and biomass relative to others. Mukhtar (2012) established that plant water status has a strong impact on plant growth and biomass production through its effect on leaf and root expansion. This therefore implies that growth and biomass result is straightforwardly equivalent to the supply and use of water (Sale, 2015; Mukhtar, 2016) and it also underlines the significance of establishing ideal water requirements for tree seedlings in order to advance growth (Mukhtar *et al.,* 2016).

The urea with highest N upake was able to influence chlorophyll concentration. Highest value of total chlorophyll a + b written from the leaf of seedlings cultivated in soil reinforced with urea is identifiable to the use of appropriate sources of nitrogen that improved the chlorophyll synthesis. The sources of nitrogen fertilizer control the chlorophyll concentration (Aref and Shetta, 2013). Aref and Shetta (2013) established that concentration of chlorophyll b was higher in *Acacia tortilis* and *Zizyphus spina-christi* seedlings treated with calcium nitrate ($CaNO_3$) under salinity stress as compared to that of ammonium sulphate $(NH4)_2S0_4$)., while the chlorophyll a and chlorophyll a+b concentration diversified between the two fertilizers. In the same consonance, Adelani *et al.* (2020b) recorded highest chlorophyll content (4.35 Mg/g) and highest relative turgidity (82.65 %) for *Chrysophyllum albidum* seedlings planted in NPK and exposed to 25 and 50 % light intensities compared to other sources of nitrogen investigated.

Highest value of chlorophyll a and chlorophyll b written from seedlings cultivated in the soil corrected accompanying cowdung may be adduced to the ability of cow dung to conserve sufficient moisture that enhanced water uptake for plant to influence formation of carbohydrate in the present of carbondioxide. It could also be inferred that manure (cowdung) conserved and provided the sufficient moisture to the plant at every developmental stage compared to inorganic fertilizer in the experiment. Appropriate water supply embellishes photosynthesis through stomatal and non-stomatal effect. During photosynthesis, water combined with carbondioxide to produce carbohydrate in the presence of sunlight. Sunlight stimulates the plant growth and development; by photosynthesis process, plants use sun-light to convert H_2O and CO_2 into carbohydrate. Photosynthetic pigments (Chl a, Chl b, and Chla+b) play a main duty in changing the solar energy to chemical energy (Liang 2000; Yuncong *et al.,* 2007). Cowdung influences chlorophyll a and chlorophyll b better than inorganic fertilizers.

Conclusion

Lack of habit to regenerate economic and indigenous tree species is a threat to biodiversity conservation. The slow growth of this indigenous and endangered species as *Chrysophyllum albidum* further discourages the propagation, regeneration as well as denying Nigerians of the associated benefits. Investigation conducted to overcome challenges of lack of regeneration habit, poor soil fertility and slow growth of *Chrysophyllum albidum* revealed that seedlings planted in the soil influenced with urea and subjected to 3 days watering regimes gave highest growth variables and promised healthy planting stock growth on the field. The amendment of soil with urea and administration of 3 days watering intervals enhances the growth of *Chrysophyllum albidum*.

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