International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2014): 5.611

Effect of Nitrogen Fertilizer and Media on Growth of African Sandal Wood (*Baphianitida* L.)

Ekwu, L. G.[1], Mbah. B. N.[2]

Department of Crop Production and Landscape Management, Ebonyi State University, Abakaliki,
Department of Crop Science, University of Nigeria, Nsukka

Abstract: ***An experiment was conducted in the screen house of the Department of Crop Production and Landscape Management of Ebonyi State University, Abakaliki, Nigeria in 2013 to determine the effect of nitrogen fertilizer and potting media on the growth of African sandal wood (Baphianitida L.). The experimental design was a 3 x 4 factorial laid out in completely randomized design (CRD). The treatments comprised three poultry manure rates (0, 3 and 6 v/v containing rice hull and riversand in the ratio of 9 :1, 6 :1 and 3: 1) and four nitrogen fertilizer rates (0, 50, 100 and 150mg/l N). The treatments were replicated five times with each replication having 20 pots that gave a total 60 experimental pots. Semi – hard wood cuttings of African sandal wood which measured 20cm were planted two per pot into 8litre pots and the pots were irrigated daily with water while dilute solution of nitrogen fertilizer was applied twice weekly with the irrigation water. Measurements taken were plant height, plant canopy width, number of leaves, number of branches, shoot dry weight and root dry weight. The results indicated that nitrogen had significant (p = 0.05) effect on plant canopy width. Plant height, number of leaves, number of branches, shoot dry weight and root dry weight recorded non – significant difference in nitrogen and media treatments. The tallest plants (21.4 cm),widest plant canopy (27.12cm), highest number of leaves (10.82), highest number of branches (4.77) and shoot dry weight (5.50g) were obtained at 50mg/l N. The medium which had no poultry manure(9:1:0 medium) produced the tallest plants (20.73cm), highest plant canopy width (25.92cm), number of leaves (9.77), shoot dry weight (4.97g) and root dry weight (0.67g) while highest number of branches was obtained in 6:1:3 medium. The medium that had the highest ratio of poultry manure (3: 1: 6 medium) consistently recorded least values in all the measurements taken.***

Key words: African sandal wood, nitrogen, rice hull, riversand, growth.

1. Introduction

African sandal wood (*Baphianitida* L.) belongs to the family Papilionaceae. Irvine[1] and Keay[2] and Cardon[3] reported that African sandal wood is an indigenous foliage shrub found in the rainforest zones of Nigeria, Cameroun, Equatorial Guinea, Ghana, Gabon, Liberia, Cote de Voire, Sao Tome, Senegal, Sierra Leone, Togo and Benin Republic. It grows as an under-storey shrub of forests and it is propagated by seed or stem cuttings. The plant grows up to 3m high and 30 cm in stem girth with slender branches. It has thick dark green and glossy leaves which may be 7 – 13 cmlong and 3.5 – 5cm wide. The bark is greyish in colour and the fruit is a pod which contains one or two dark brown flat seeds.

Irvine[1] reported that African sandalwood is planted in rural communities around sacred grooves and used for fencing, as house posts, rafters, walking sticks, handles for knives, axes, mortars and farm implements.Olowosolu and Ibrahim[4] found that the wood of African sandal wood yields a red or brown dye which contains a substance called isosantaline. This alkali is soluble in water and is used in the dyeing of linen and cotton. Ubani*et al*. [5]and Ubani*et al*. [6] observed that in many West African communities, the ground powdered heart wood of African sandal wood (camwood) is made into a paste and used as cosmetic for the skin. Guere and andKrou healers of Cote de Voire use the paste for religious ceremonies and in Ghana, warriors who had killed an enemy or a leopard paint their foreheads with camwood for ritual dances. Camwood was exported on a large scale from West Africa to Europe and North America from the 17th century as one of the main "redwood"dyes for wool, cotton and silk. It was rated as having a colouring power three to four times stronger than the other insoluble dyes used in Europe and North America at the time.

In Nigeria, the Tiv people colour the inside of their gourds prepared as a beehive with the red dye to attract a swarm of bees to settle there. Yoruba honey – hunters rub their body with the dye paste to prevent bee stings [7]. The leaves are used as fodder and in Southern Ghana, African sandal wood is recommended in livestock rearing areas because of its palatability, continuous availability and high protein content. The twigs are used as chewing sticks [5] and [6].Keay and Onochie[8] andKeay[2] reported that in Nigeria, the dried powdered root is mixed with waterand oil and used in treating ring worm. African sandal wood is also used as an embrocation for stiff joints, rheumatic pains and sprains.

The choice of the amount of fertilizer to apply to a specific foliage crop varies with the growing environment. Some major factors that may influence fertilizer requirement of pot plants include irrigation level, light intensity, temperature and cation exchange capacity [9]. Green [10] noted that nitrogen is required in large quantities by plants and it is easily leached during irrigation, making it the most difficult nutrient to manage in a container production system. Gilliam and Wright[11] found that *Ilex crenata* and *Ilex cornuta* fertilized with 200, 300, 400 and 500 ppm N did not increase shoot growth with nitrogen rates higher than 300 ppm N. They reported that increasing the rate of nitrogen beyond 300 ppm N led to a reduction in the calcium, magnesium and potassium concentrations in plant tissues. In a trial using two azalea cultivars, Niemiera and Wright [12] observed that shoot length decreased as the nitrogen rates increased while the root dry weight increased as the nitrogen rate increased from 15ppm N to 25ppm N but beyond 25ppm N, root dry weight decreased. Nelson *et al*.[13] reported that

400 ppm N or less applied weekly to *Rieger begonia* resulted in undesirable plant size reduction regardless of the potassium level, 200 ppm N was marginal while 250 ppm N was the best.

Griffin *et al.*[14]observed that 100 ppm N maximized the growth of „Green giant" when it was applied three times weekly. A decrease in root production of Craple myrtle and *Thujaoccidentalis* was observed as the level of the available nitrogen increased from 0ppm N to 320ppm N [15 and 14].Mastalerz[16] reported that nitrogen is often the limiting nutrient in plant growth and when it is supplied in sufficient quantity, it ensures optimum growth of plants. Fertilizer rate had no significant effect on the growth of *Chamaedoraelegans* but *Diffenbachiamaculata* grew taller and received higher plant grades as the fertilizer rates increased from 3g N/6 inch pot to 9g N/6 inch pot [17]. Hickleton[18] observed that in *Cotoneaster dammeri*, the growth rate increased as the weekly nitrogen applications increased from 70 to 420mg N/week. Anthony [19] found that *Ilex glabra* grown with 3:2:1 pine – bark :peat : sand and mixed with recycled waste at the rate of 0%,25%,50%,75% and 100% showed a significant reduction in shoot dry weight at 100%.

Miva and Ozaki [20]reported that high nitrogen rates (320 – 400ppm N/l) had adverse effect on plant growth in many cases but in some, they promoted growth depending on the nitrogen form, soil pH and the species tested. There have been a number of studies that showed that plants have higher nutrient uptake efficiency at lower levels of nutrient application and nutrient efficiency decreases significantly with increasing rates of nutrient addition[21,22,23, 24,25and 26].Chase and Poole [27] reported that golden pothos stock plants and cuttings that received urea at 4g/6 inch pot had more leaves , fewer damaged leaves and higher top quality grades than plants fertilized at the other fertilizer rates tested (1, 2, 3 or 5g/6 inch pot).

Growing media are typically mixtures of two or more components with physical and chemical properties that differ from those of the individual components. While there is no one standard growing medium recommended for all container crops under all growing conditions, there are recommended physical and chemical properties for container media. The use of garbage or municipal solid waste compost in container production was an idea that was considered at least 50 years ago [28].Duke *et al.*[29] reported that growers are becoming interested in production strategies that offer greater environmental stability while reducing expensive inputs of synthetic fertilizer, imported substrate components, chemical pesticides and water. Uniform rooted cuttings of Emerald Gaeity, Goldflame and Compactus were grown using pine – bark and poultry litter at 0, 5, 10, or 20% by volume. Amy [30] reported that the addition of poultry litter at 20% by volume significantly reduced quality for all the three species.

Helen *et al.*[31] observed that composted turkey litter added to a pine – bark substrate increased substrate temperature. Decreased metabolic activity and plant growth resulted from these high temperature exposures. Container water holding capacity also increased quadratically with increasing compost with a maximum occurring at 8% compost. Composted turkey litter added to a pine – bark substrate increased bulk density and container water – holding capacity while the air space decreased.This also resulted in increased thermal conductivity and diffusivity compared to pine - bark alone [32].Tyler [33] reported that turkey broiler compost added at 10 and 20% to pine – bark and sand (4:1v/v) increased total porosity, electrical conductivity, leachate phosphorus, calcium, magnesium and pH. Container capacity increased three to six percent by volume. Rooted cuttings of „Skolgholm" cotoneaster was propagated using five compost rates (0, 4, 8, 12 and 16%) and three irrigation frequencies (watering every day, every two days or every three days).Helen *et al.* [34] attributed the decrease in root dry weight at 16% compost to higher nutrient concentration and water content of the 16% compost amended substrates.Conover and Joiner [35]observed that *Chrysanthemum* grown with mix composed of 100% garbage compost had higher salt levels and produced poor quality plants compared to other mixes which contained no compost or lesser volumes of compost. Bragg *et al.* [36] also reported that there was growth reduction in several bedding plants grown in peat, coir or wood fibre media amended with composted biosolid or fully composted domestic refuse. Vikram[37] obtained a higher number of branches in *Vincearosea* in medium containing worm castings and soil.

Garry and Jim [38]observed an increase in leaf area, shoot and root dry weight of French marigold grown in medium amended with 10% vermicompost. Atiyeh*et al.*[39] andAtiyeh*et al.*[40] also obtained an increase in shoot dry weight of French marigold grown in media amended with vermicompost. The growth of *Lagerstroemia* in mixes containing composted yard waste was greater than those in the commercial potting mix (mix that had no compost)[41].Grappelli*et al.*[42] obtained the greatest values for root initiation, root elongation and root biomasswhen worm castings alone were used in the propagation of several ornamental species while Devitt*et al.*[43] showed that in periwinkle, compost application resulted in greater plant growth.Leachate collected from pine – bark amended with 0%,5%, 10%, 20%, 30% and 40% composted poultry litter showed that all poultry litter additions resulted in excessive soluble salts after the application of 200mls of water [44].

Bilderback and Fonteno[45] observed that an addition of 33% by volume of composted poultry litter increased pH, electrical conductivity, NO_3 – nitrogen, potassium, phosphorus, calcium and magnesium levels.James [46] reported that the high initial high levels of soluble salts found in pine – bark amended with composted poultry litter caused plant injury.Wilson *et al.*[47] observed that the growth of *Orthosiphonstamineus* and *Angeloniaanguistifolia* was reduced when grown in peat or coir based media amended with high rates of compost (75 or 100%). They noted that as the percentage of compost increased, pH, electrical conductivity, percent nitrogen and carbon increased. Usman*et al.*[48] found that sewage sludge contained a maximum amount of nitrogen but overall it had no contribution to plant growth. They observed that this was because macro and micronutrient availability may not be sufficient to support plant growth when the pH of the growing media is as high as 7.1 – 7.8. Bunt [49] recommended that not more than 30% by volume of compost should be used in the medium for growing pot plants.

Digested biosolid compost was added at various rates to a peat – vermiculite mix and marigold growth was analyzed. Chaney *et al*.[50] observed that the addition of 33% compost provided all the trace element requirement, corrected phosphorusand copper deficiencies and produced suitable plant growth with the addition of nitrogen. Fitzpatrick [28] reported that when inorganic fertilizer N was incorporated with compost, efficiency and improved crop response was higher than without compost. Usman*et al*.[48]reported that the chemical analysis of the media used in their study showed that sewage sludge contained the highest amount of nitrogen compared to other media (silt, coconut coir dust, spent mushroom and ricehull) but its availability to the plants was restricted due to the higher pH of the growing medium.The objective of the study was to determine the effect of various levels of nitrogen fertilizer and poultry manure for the production of African sandal wood as a foliage pot plant.

2. Materials and Methods

The experiment was carried out at the screen house of the Department of Crop Production and Landscape Management, Ebonyi State University, Abakaliki. The experimental design was a 3 x 4 factorial laid out in a completely randomized design (CRD). The treatments comprised three poultry manure rates (0, 3 and 6v/v containing ricehull and rivers and in the ratio of 9:1, 6:1 and 3:1) and four nitrogen fertilizer rates (0, 50, 100 and 150mg/l N) which gave a total of twelve treatment combinations. The treatments were replicated five times with each replication having 20 experimental pots that gave a total of 60 experimental pots. Ricehull was sourced from Abakaliki Rice Mill PLC. Rivers and was obtained from the rivers and depot along Enugu – Abakaliki express way while poultry manure was sourced from the Department of Animal Science, Ebonyi State University, Abakaliki. Fresh ricehull was composted for 30 days while poultry manure was composted for 3months.The growing media which comprised of rice, rivers and and poultry manure in the ratio of 9:1:0, 6:1:3 and 3:1:6 was steam sterilized and semi – hardwood cuttings of African sandal wood measuring 20cm each was planted two per pot in to 8litre pots. The source of nitrogen was urea. Stock solution of nitrogen fertilizer was prepared and dilute solution of the fertilizer was applied twice weekly with the irrigation water. The plants were watered daily with water. Chemical analysis of the media used was determined for nitrogen using the modified Kjhedahl method as described by Pearson [51] while phosphorus, potassium, calcium and magnesium were determined by the use of atomic absorption spectrophotometer. Determination of pH was by the use of glass electrode pH meter. The following measurements were taken: plant height, plant canopy width, number of leaves, number of branches, shoot dry weight and root dry weight.

Statistical analysis of data was done using ANOVA for completely randomized design (CRD) and mean separation and comparison was by the use of Fishers Least Significant Difference (FLSD) as described by [52].

The following media were used to formulate the mixtures:
(a) Ricehull
(b) Riversand
(c) Poultry manure

Media formulation

The media were formulated by mixing the above media in the following ratios:
(i) 9 : 1: 0 = Ricehull : riversand : poultry manure
(ii) 6 : 1: 3 = Ricehull : riversand : poultry manure
(iii) 3 : 1 :6 = Ricehull : riversand : poultry manure

Table 1 show the chemical composition of the media used in the experiment. The analysis showed that the percentage of nitrogen, phosphorus, potassium, calcium and magnesium was highest in 3 : 1: 6 medium (medium with the highest percentage of poultry manure) followed by 6: 1 : 3 medium. The lowest percentage of these elements was obtained in 9: 1:0 medium. The pH of 3: 1: 6 medium was also higher than 6: 1:0 and 9:1:0 medium.

Table 1: Chemical composition of media

Media (v/v) RH : RS: PM

Nitrogen (mg/l)	9 :1 : 0	6 : 1: 3	3:1:6
%N	0.700	1.040	1.120
Mg/l P	0.455	0.720	1.200
Kmeq/100g	0.060	0.340	0.435
%Ca	0.802	1.202	1.403
%Mg	0.122	0.122	0.243
pH	7.0	7.5	7.8

3. Results and Discussion

Plant height

There was non – significant difference in plant height among the nitrogen, media and nitrogen x media treatments (Table 2). The tallest plantswas obtained at 50mg/l N while the shortest plants was produced at 150mg/l N. However, plant height increased as the nitrogen fertilizer rate increased from 0mg/l N to 50mg/l N beyond which there was no further increase in height. Nitrogen application at 50mg/l N was sufficient and additional fertilizer beyond this level had a negative effect. The decrease in plant height as the nitrogen fertilizer rate increased could also be attributed to high soluble salt levels and a decrease in nutrient uptake efficiency at higher fertilization levels. A number of studies showed that plants have higher nutrient uptake efficiency at lower levels of nutrient application and nutrient efficiency decreases significantly with increasing rates of nutrient addition [21, 22, 23, 24, 25 and 26].

Plant height decreased as the ratio of poultry manure increased from zero to six. The tallest plants was produced in 9: 1: 0 medium while the shortest plants was obtained in 3: 1:6 medium.The addition of poultry manure increased bulk density and water – holding capacity of the medium, thereby decreasing air space. Hillel [32],Tyler*et al*.[33] andHelen *et al*.[31] reported that composted turkey litter added at 10% and 20% to a pine – bark substrate increased bulk density and container holding capacity three to six times by volume while air space decreased. Helen *et al*.[31]

also observed that container capacity increased quadratically with increasing compost rate with a maximum occurring at 8%.

Table 2: Effect of nitrogen and media on plant height (cm)
Media (v/v) RH : RS: PM

Nitrogen (mg/l)	9 :1 : 0	6 : 1: 3	3:1:6	Mean
0	20.38	21.07	19.15	20.20
50	22.61	22.15	19.48	21.41
100	20.38	20.28	18.55	19.73
150	19.57	17.70	19.43	18.90
Mean	20.73	20.30	19.15	

F- LSD (P = 0.05) Media : RH : RS : PM
Nitrogen =NSRH = Rice hull
Media = NSRS = Riversand
Nitrogen x Media = NS PM = Poultry manure

Plant Canopy Width

Nitrogen fertilizer rates significantly (p = 0.05) affected plant canopy width (Table 3).The widest canopy was produced at 50mg/l N while the least canopy width was obtained at 150mg/l N and they differed significantly. Plant canopy width produced at 0, 50 and 100mg/l N were statistically identical. Plant canopy width did not increase beyond 50mg/l N. This could be attributed to the adverse effect of nitrogen rates above 50mg/l N on the growth of the plants. Miva and Ozaki [20] found that high nitrogen rates (320 – 400ppm N) had adverse effect on the growth of native *Rhododendron* species. The growth of the plants may have been depressed beyond 50mg/l N.

The effect of media on plant canopy width was non – significant (Table 3). Although, the medium where poultry manure was omitted (9 :1: 0) produced the highest plant canopy width while the least canopy width was recorded in 3: 1: 6 medium (medium with the highest ratio of poultry manure). Plant canopy width decreased as the poultry manure ratio increased from zero to six. In this study, the addition of poultry manure increased media temperature, leading to increased thermal conductivity, decreased metabolic activity and plant growth. A similar report byHelen *et al*.[31]showed that composted turkey litter added to a pine – bark substrate increased substrate temperature, decreased metabolic activity and plant growth as a result of high temperature exposures. Nitrogen x media interaction had no significant effect on plant canopy width. However, plant canopy was widest at 50mg/l N in 6:1: 3 medium and lowest at 150mg/l N in 6:1:3 medium. The addition of 30% poultry manure (6 : 1 : 3) in our potting medium may have provided all the macronutrients and micronutrients necessary for plant growth. This observation is consistent with the report by Chaney *et al*. [50] who found that the addition of 33% compost provided all the trace element requirement, corrected phosphorus and copper deficiencies and produced suitable plant growth with the addition of nitrogen. Fitzpatrick [28] also reported that when inorganic fertilizer N was incorporated with compost, efficiency and improved crop response was higher than without compost. Bunt [49] recommended that not more than 30% by volume of compost should be used in the medium for growing pot plants.

Table 3: Effect of nitrogen and media on plant canopy width (cm)
Media (v/v) RH : RS: PM

Nitrogen (mg/l)	*9 :1 : 0*	*6 : 1: 3*	*3:1:6*	*Mean*
0	30.00	26.40	21.85	26.08
50	27.55	30.15	23.65	27.12
100	22.17	22.88	26.65	23.90
150	23.95	17.82	20.50	20.76
Mean	25.92	24.31	23.16	

F- LSD (P = 0.05) Media : RH : RS : PM
Nitrogen = 3.99 RH = Rice hull
Media = NS RS = Riversand
Nitrogen x Media = NS PM = Poultry manure

Number of Leaves

Nitrogen fertilizer, media and their combination had no significant effect on number of leaves produced (Table 4). Nitrogen rate of 50mg/l N produced the highest number of leaves while the least number of leaves was at 0mg/l N. The number of leaves increased as the nitrogen fertilizer rate increased from 0mg/l N to 50mg/l N but not beyond 50mg/l N. Nitrogen fertilizer rate beyond 50mg/ N depressed the growth of the plants leading to the production of fewer leaves as the rate increased to 150mg/l N. A similar report by Chase and Poole [27] showed that golden pothos stock plants and cuttings that received urea at 4g/6 inch pot had more leaves , fewer damage leaves and higher top quality grades than plants fertilized at the other fertilizer rates tested (1, 2, 3 or 5g/6 inch pot).

The number of leaves decreased as the ratio of poultry manure in the medium increased from zero to six. Number of leaves was highest in the medium where poultry manure was omitted (9: 1: 0 medium) and lowest in the medium with the highest ratio of poultry manure (3: 1:6 medium). In our study, the reduction in the number of leaves as the poultry manure ratio increased could be as a result of the higher pH values obtained in the medium with poultry manure which hindered the availability of sufficient macronutrients and micronutrients needed for plant growth. This observation is consistent with the report by Usman*et al*.[48] who found that macronutrient and micronutrient availability may not be sufficient to support plant growth when the pH of the growing media is as high as 7.1 – 7.8. Wilson *et al*.[47] also reported that the growth of *Orthosiphonstamineus* and *Angeloniaanguistifolia* was reduced when grown in peat or coir based media amended with high rates of compost (75 or 100%). They noted that as the percentage of compost increased, pH, electrical conductivity, percent nitrogen and carbon increased. Number of leaves was highest at 50mg/l N in 6: 1:3 medium while the least number of leaves was obtained at 150mg/l N in 6:1: 3 medium.

Table 4: Effect of nitrogen and media on number of leaves
Media (v/v) RH : RS: PM

Nitrogen (mg/l)	9 :1 : 0	6 : 1: 3	3:1:6	Mean
0	9.60	7.78	9.06	8.81
50	11.00	11.62	9.85	10.82
100	9.34	11.31	7.99	9.55
150	9.13	7.48	8.78	9.46
Mean	9.77	9.55	8.92	

F- LSD (P = 0.05) Media : RH : RS : PM

Nitrogen = NS RH = Rice hull
Media = NS RS = Riversand
Nitrogen x Media = NS PM = Poultry manure

Number of Branches

Nitrogen fertilizer rate of 50mg/l N which produced the tallest plants, highest plant canopy width and number of leaves also produced the highest number of branches while the least number of branches was recorded at 150mg/l N (Table 5). There was non – significant effect of fertilizer on number of branches. Number of branches increased up to 50mg/l N with a decrease beyond this rate. The decrease in number of branches beyond 50mg/l N could be attributed to the adverse effect it had on plant growth. A similar observation byMiva and Ozaki [20] showed that high nitrogen rates (320 – 400ppm N) had adverse effect on the growth of native *Rhodendron* species.

Media had non – significant effect on number of branches (Table 5). Although, number of branches was highest in 6 :1: 3 medium while least number of branches was produced in 3:1:6 medium.This is in conformity with Vikram[37] whoobtained a higher number of branches in *Vincearosea* in medium containing worm castings and soil.Broschat[41] also reported that the growth of *Lagerstroemia* in mixes containing composted yard waste was greater than those in the commercial potting mix (potting mix which had no compost). The medium with the highest ratio of poultry manure (3: 1: 6 medium) which produced the shortest plants, lowest canopy width and number of leaves also recorded the lowest number of branches. This observation could be attributed to high soluble salts which had negative effect on the growth of the plants. The chemical analysis of the growing media showed that this medium (3:1:6)had the highest percentage of nitrogen, phosphorus, potassium, calcium, magnesium and the highest pH value. Our observation is supported by the work of Hutchinson and Griffin[44] who reported that leachate collected from pine – bark amended with 0%,5%, 10%, 20%, 30% and 40% composted poultry litter showed that all poultry litter additions resulted in excessive soluble salts after the application of 200mls of water. Wilson *etal*.[47] also observed that the high initial high levels of soluble salts found in pine – bark amended with composted poultry litter caused plant injury. Nitrogen x media interaction was non – significant on number of branches.

Table 5: Effect of nitrogen and media on number of branches

Media (v/v) RH : RS: PM

Nitrogen (mg/l)	9 :1 : 0	6 : 1: 3	3:1:6	Mean
0	4.81	4.96	4.31	4.70
50	4.49	4.82	5.00	4.77
100	4.46	4.55	3.80	4.27
150	4.21	4.25	3.72	4.06
Mean	4.49	4.65	4.21	

F- LSD (P = 0.05) Media : RH : RS : PM
Nitrogen = NS RH = Rice hull
Media = NS RS = Riversand
Nitrogen x Media = NS PM = Poultry manure

Shoot Dry Weight

Nitrogen did not significantly affect shoot dry weight (Table 6). However, shoot dry weight was highest at 50mg/l N and lowest at 150mg/l N. Shoot dry weight decreased as the nitrogen rate exceeded 50mg/l N. A decrease in nutrient uptake efficiency at higher nitrogen rates led to the low shoot dry weight obtained at nitrogen rates beyond 50mg/l N[21, 22, 23, 24, 25 and 26].Gilliam and Wright[11] reported that *Ilex crenata* and *Ilex cornuta* fertilized with 200, 300, 400 and 500 ppm N did not increase shoot growth with nitrogen rates higher than 300 ppm N. They reported that increasing the rate of nitrogen beyond 300 ppm N led to a reduction in the calcium, magnesium and potassium concentrations in plant tissues.

Media had non- significant effect on shoot dry weight (Table 6). Shoot dry weight was highest in 9:1:0 medium while the least shoot dry weight was obtained in 3: 1:6 medium. The addition of poultry manure increased bulk density and water – holding capacity of the medium, thereby decreasing air space ([32], [33] and[31]).Anthony and Nick[19] found that *Ilex glabra* grown with 3:2:1 pine – bark :peat : sand and mixed with recycled waste at the rate of 0%,25%,50%,75% and 100% showed a significant reduction in shoot dry weight at 100%. A similar observation was made by [35]. Nitrogen x media interaction did not significantly affect shoot dry weight.

Table 6: Effect of nitrogen and media on shoot dry weight (g)

Media (v/v) RH : RS: PM

Nitrogen (mg/l)	9 :1 : 0	6 : 1: 3	3:1:6	Mean
0	5.03	3.85	3.28	4.05
50	5.58	5.99	4.91	5.50
100	5.38	4.40	4.21	4.66
150	3.88	3.00	4.81	3.90
Mean	4.97	4.31	4.30	

F- LSD (P = 0.05) Media : RH : RS : PM
Nitrogen = NS RH = Rice hull
Media = NS RS = Riversand
Nitrogen x Media = NS PM = Poultry manure

Root dry weight

The effect of nitrogen fertilizer on root dry weight was non-significant (Table 7). Although, highest root dry weight was recorded at 0mg/l N while lowest root dry weight was at 150mg/l N. Root dry weight decreased as the nitrogen rate increased from 0mg/l N to 150mg/l N. This observation agrees with the report by Cabrera and Devereaux [15] and Griffin *et al*.[14] who found that there was a decrease in root production in Craplemyrtle and *Thujaoccidentalis*as the level of nitrogen increased from 0ppm N to 320ppm N.Mastalerz[16] reported that higher rates of nitrogen inhibited the growth of strawberry .

Media had non - significant effect on root dry weight (Table 7). Root dry weight was highest in 9:1:0 medium while lowest root dry weight was obtained in 3:1:6 medium. Root dry weight decreased as the poultry manure ratio in the medium increased from zero to six. The decrease in root dry weight as the volume of poultry manure increased in this study supports the idea that higher nutrient concentration and water content of our medium must have played a major role in restricting plant growth This finding could also be attributed to high soluble salts that inhibited root growth in the medium with the highest percentage of poultry manure (3:1: 6 medium).Helen *et al*.[34] attributed the decrease in root dry weight at 16% compost to higher nutrient concentration and water content of the 16% compost amended substrates. There was non – significant interaction between nitrogen fertilizer and media.

Table 7: Effect of nitrogen and media on root dry weight (g)
Media (v/v) RH : RS: PM

Nitrogen (mg/l)	9 :1 : 0	6 : 1: 3	3:1:6	Mean
0	0.63	0.71	0.55	0.63
50	0.66	0.72	0.48	0.62
100	0.69	0.48	0.50	0.56
150	0.69	0.46	0.49	0.54
Mean	0.67	0.59	0.51	

F- LSD (P = 0.05) Media : RH : RS : PM
Nitrogen = NS RH = Rice hull
Media = NS RS = Riversand
Nitrogen x Media = NSPM = Poultry manure

References

[1] F. R. Irvine, Woody plants of Ghana, Oxford Press London, 1961.
[2] R..W.D.Keay, Trees of Nigeria. Claredon Press, Oxford, 1989.
[3] D. Cardon, (2003). Le monde des teinturesnaturelles, Berlin, Paris, France. 2003.
[4] A.K. Olowosulu, and Y.K.E. Ibrahim, "Studies on the antimicrobial properties of *Baphianitida* L. (Camwood) extract," Nigerian Journal of Microbiology, 20 (1), pp. 661 – 668, 2006.
[5] O. N. Ubani, O.O. Tewe, and L. Moody, "Anti – nutritive and toxic factors in trees and shrubs used as browse." Tropical Science. (40), pp. 159 – 161, 2000.
[6] O.N. Ubani, and O.O. Tewe, "The nutritive value of some tree shrub leaves as feed for goats" Tropical Science, (41), pp. 13 – 15, 2001
[7] P. Barnes, "Herbage yields and quality in four woody forage plants in a subhumid environment in Ghana,"Journal of Agroforestry Systems, 42(1), pp. 25 - 32, 1998.
[8] R.W.D. Keay, and C.F.A. Onochie, Nigerian Trees, Nigerian National Press Ltd, Apapa, 1964.
[9] C. A. Conover, and R. T. Poole, "Light and fertilizer recommendations for production of acclimatized potted foliage plant," Foliage Digest. 13 (6): 1 - 6, 1990
[10] J. L. Green, "Practices to minimize contamination of ground water and runoff in greenhouse andnursery production of container – grown plants," Ornamentals Northwest Newsletter, 13 (3), pp. 9 – 16, 1989.
[11] C. Gilliam, and R. D. Wright, "Effect of four nitrogen levels on soil, soil solution and tissue nutrient levels in three container – grown *Ilex* cultivars," Journal of Amer. Soc. HortScience, 102 (5), pp. 662 – 664, 1980.
[12] A.X. Niemiera, and R.D. Wright, "The influence of media nitrogen level on the growth of *Ilex crenata*,"Hort. Sci, 16 (3), pp. 293, 1981.
[13] P.V. Nelson, D. M. Krauksopt, and N. C. Mingis, "Nitrogen and potassium requirements of *Rieger begonia*," Hort. Abstr, 979: 2019, 1978.
[14] J.J. Griffin, S. L. Warren, F. A. Blazich, and T. G. Ranney, "Nitrogen nutrition of containerized *Thuja* x "Green Giant,‟ Journal of Environ. Hort, (17), pp. 76 - 79, 1999
[15] R. I. Cabrera, and D. I. Devereaux, "Effect of nitrogen supply on growth and nutrient status of containerized Craple myrtle," Journal of Environ. Hort, (16), pp. 98 – 104, 1998.
[16] J.W. Masterlerz, The Greenhouse Environment, John Wiley and Sons Inc, USA, 1977.
[17] C. A. Conover, and R. T . Poole, R.T. "Light and fertilizer recommendations for production of acclimatized potted foliage plants," CFERC Apopka Research Report, p. 14, 1991
[18] P. R.Hickleton, "Growth analysis of „*Pumusacompacta'* juniper and „Coral Beauty‟cotoneaster subjected to different nitrogen fertilizer regimes," Journal of Environ Hort, (8) pp. 192 – 196, 1990.
[19] W. Anthony, and J. G. Nick, "Use of recycled waste as an amendment in container production media," I n Proceedings of the SNA Research Conference, (48), pp. 71-73, 2003
[20] S. Miva, and H. Ozaki, "The effect of nitrogen fertilizer and soil pH on the growth of some native *Rhododendron* species," Bull. Schzuioka Agric. Station, (21), pp. 67- 68, 1976.
[21] R.I. Cabrera, and R.Y. Devereaux, " Cycling nitrogen uptake by greenhouse roses," ScientiaHort, 63 (1 – 2), pp. 57 – 66, 1995.
[22] M.W. Kent, and D.W.Reed, "Nitrogen nutrition of new *Guinea impatiens*„Barbados‟ and*Spathiphyllum* „Petite‟ in a subirrigation system" Journal of the American Society of HortSci, 121 (5), pp. 816 – 819, 1996.
[23] J. D. Lea – Cox, and J.P. Syvertsen, "How nitrogen supply affects growth and nitrogen uptake, use efficiency and loss from citrus seedlings," Journal of the American Society of HortSci, 121 (1), pp. 105 – 114, 1996.
[24] C.S.M. Ku, and D.R. Hershey, "Growth response, nutrient leaching and mass balance for potted Poinsettia," Journal of the American Society of HortSci, 122 (3) pp. 452 – 458, 1997.
[25] R . I Cabrera, (2003). "Nitrogen balance for two container grown woody ornamental plants, ScientiaHort, 97 (3- 4), pp. 297 – 308, 2003.
[26] A.G. Ristvey, J.D. Lea – Cox, and D.S. Ross, "Nutrient uptake, partitioning and leaching losses from container – nursery production systems," ActaHorticulturae,. (630) pp. 321 – 328, 2007.
[27] R. A. Chase, and R. T. Poole, " Effect of urea nitrogen and potassium ratios on golden pothos stock plants and cuttings," CFREC – Apopka ResearchReport, RH – 92 – 6. 1992.
[28] G. E. Fitzpatrick, "Compost utilization in ornamental and nursery crop production system. In: Stofella P.J. and B.A. Kahn (eds) Compost utilization in horticultural cropping systems," Lewis Publishers, Boca Raton FL. 2001.

[29] E. R. Duke, G. W. Knox, A. Bolques, and S. Bos, "Utilization of alternative organic amendment as substrate components: physical and chemical properties." In Proceedings of the SNA Research Conference, (48), pp. 55 – 58, 2003a
[30] F. Amy, " Use of pelletized poultry litter as a container substrate.," InProceedings of the SNA Conference, (47), pp. 73 – 76, 2002.
[31] T. Helen, L. W. Stuart, and T. E. Bilderback, "Nitrogen and phosphorus efficacy of commercial synthetic and organic fertilizers in container production," In Proceedings of the SNA Research Conference, (38), pp. 96 – 99, 1993
[32] D. Hillel, Soil temperature and heat flow. In: Introduction of Soil Physics," Academic Press, New York, 1982.
[33] H.H. Tyler, S.L. Warren, T.E. Bilderback, and W.C. Fonteno, "Composted turkey litter: 1. Effect on chemical and physical properties of a pine – bark substrate," In Proceedings of the SNA Research Conference, (37), pp. 90 – 93, 1992.
[34] T. Helen, B. P. Kathrine, and L. W. Stuart, "Composted turkey litter : Effect on the thermal characteristics of an amended pine bark substrate," In Proceedings of the SNA Research Conference, (38), pp. 92 – 95,1992.
[35] C. A. Conover, and J. N. Joiner, J.N. " Garbage compost as a potential soil component in production of *Chrysanthemum morifolium* „Yellow Delaware‟ and „Oregon," In Proc. Fla State Hort. Soc, (79), pp. 424 – 429, 1996
[36] N. C.Bragg, J. A. R Walker, and E. Stentiford, E. "The use of composted refuse and sewage as substrate additives for container grown plants."ActaHort, (342), pp. 155 – 165. 1993.
[37] K. Vikram, "The effect of *Phertinaalexandri* (Beddard) on the growth of *Vincarosea* and*Oryza sativa*" In : Earthworms in waste and environmental management eds. CA Edwards and E.F. Neuhauser. pp 211 – 219. Academic Publishing, The Hague, The Netherlands, 1988.
[38] R. B. Garry, and M. Jim, "The use of vermicompost as a media amendment," In Proceedings of the SNA.Research Conference, (43), pp. 32 – 34, 1998.
[39] R. M..Atiyeh, N. Arancon, C. A. Edwards, and J. D. Metzger, "Influence of earthworm – processed pig manure on the growth and yield of greenhouse tomatoes," Journal of BioresourceTechnol, (75), pp. 75 – 180, 2000.
[40] R.M. Atiyeh, N. Arancon, C.A. Edwards, and J. D. Metzger, "The influence of earthworm – processed pig manure on the growth and productivity of marigolds," Journal of BioresourceTechnol, (81), pp. 103 – 108, 2002.
[41] K. Broschat, " Manganese binding by municipal waste composts used as potting media,." Tropic Line, 4(4), pp. 1 – 4, 1991.
[42] A. Grappelli, U. Tomati, and E. Galli, (1985). "Earthworm castings in plant propagation," Journal of HortScience, 20 (5), pp. 874 -876, 1985.
[43] D. A. Devitt, R. L. Morris, and D. C. Bowman, "Response of periwinkle to composted sewage sludge used as a soil amendment," Journal of. Environ Hort, 9(4), pp. 176 – 181, 1991.
[44] M. Hutchinson, and T. S.Griffin, "Evaluation of fibre content relative to other measures of compost stability," Journal of Compost Science and Utilization, (16) 6 – 11, 2008.
[45] T. E. Bilderback, and W. C. Fonteno, "Use of horticultural rockwool, poultry litter compost and pine bark as container media," In Proceedings of the SNA Research Conference, (36), pp. 61 – 63, 1991.
[46] T.M. James, "Preliminary evaluation of composted poultry litter as a potting mix component," In Proceedings of the SNA Research Conference. (40), p. 97, 1995.
[47] S.B.WilsoN, P.J. Stofella, and D. Graetz, "Use of compost as a media amendment for containerized production of two subtropical perennials" Journal of Environ Hort. 19 (1), pp. 37 – 42. 2001.
[48] T. Usman, U.R. Shoaib, S.K. Muhammad, and Y. Adnan, "Agricultural and municipal waste as potting media components for the growth and flowering of *Dahlia hortensis*„Figaro,‟ Turk Journal of Botany, (36), pp. 378 – 385, 2012.
[49] A. C. Bunt, Modern Potting Composts, Allen and Unwin, London. 1976.
[50] R.L. Chaney, J.B. Munns, and H.M. Cathey, " Effectiveness of digested sewage sludge compost in supplying nutrients for soilless media,."Journ. American Society of Hort. Sci, (105), p. 485, 1980.
[51] D. Pearson, The chemical Analysis of Foods, 7thEdn, Churchill Livingstone Pub. Co London and New York, 1976.
[52] I.U. Obi, Statistical Method of Detecting Differences between Treatment Means, SNAAP Press Limited, Enugu, Nigeria, 1986.