Influence of Organic Fertilizers on the Growth Performance of *Eucalyptus torilliana* Seedlings in Nasarawa State, Nigeria

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ABSTRACT

The study aimed to investigate the influence of organic fertilizers on the growth performance of Eucalyptus torilliana seedlings in Nasarawa, Nigeria. Seeds were sown in germination boxes filled with topsoil. At four weeks after germination, 240 seedlings were randomly selected and transplanted into polythene pots filled with 1000 g of top soil. After two weeks of acclimatization, 5 g and 10 g each of poultry manure and cattle dung and 0 g of control were applied as treatments. The experiment was laid out in a completely random design with four treatments. Each treatment consists of 60 experimental pots. Seedling variables such as plant height, number of leaves, leaf area, collar girth, leave length, and leave width were taken fortnightly. The collected data was subjected to an analysis of variance at p <0.05. Results indicated that organic fertilizers significantly (p <0.05) improved the growth of E. torilliana seedlings over the control. The highest mean plant height (9.24±2.29a) was recorded on seedlings treated with poultry manure + cattle dung. Seedlings treated with 10 g of poultry manure produced the greatest mean collar girth (2.05±0.35 a). The best mean number of leaves (9.65±5.62a) was obtained in seedlings treated with poultry manure and cattle dung. There were significant differences (p<0.0.5) in plant height) from week 3 (6.33±1.53f) to week 8 (10.10±1.83a). Poultry manure plus cattle dung performed better than cattle dung, while control performed the least. It is recommended that the application of poultry manure and cattle dung for proper growth of E. torilliana should be encouraged for plantation establishment.

INTRODUCTION

A significant species of tropical tree, Eucalyptus torelliana F. Muell has a wide range of applications and high economic values. The plant, which is tall and evergreen and is a member of the Myrtaceae family, is described as having an irregular crown, grey-green bark, and a persistently scaly, sub-fibrous base (Adeniyi and Ayepola, 2008). It is the second-most widely distributed species of multipurpose woody tree in the world and can reach heights of 30 m while maintaining a straight trunk and good form in a range of environmental conditions (Coffi*et al*., 2012; Pinto *et al*., 2016). It has lovely flowers that are large, creamy white clusters and have numerous valves that are well below the fruit's rim (Adeniyi *et al*., 2006). The different soil types, including loamy soils, sands, and clays, can support the growth of the various tree species. Africa's population pressure has changed the land's cover and urged the growth of woodlots. It has long been recommended to plant exotic tree species such as Eucalyptus to relieve pressure on native forests and woodlands (Boland *et al*., 2006).

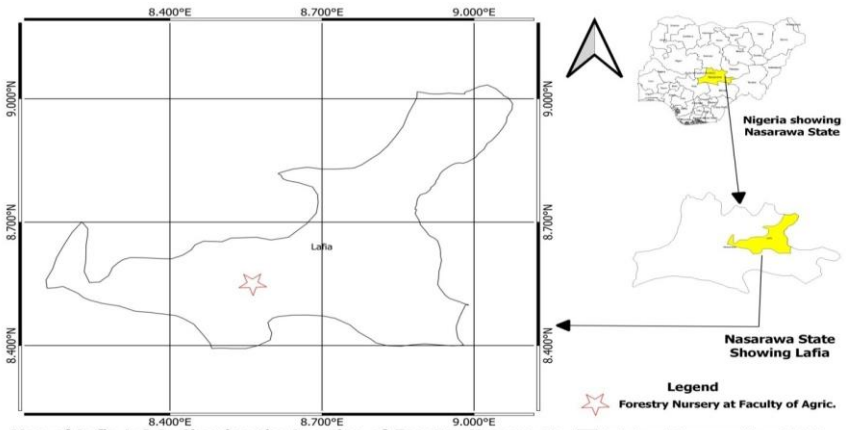
Farmers plant such a tree species because of the rising demand for wood products, the lack of wood on farms, the high rate of biomass production, the ease of cultivation, and the tree's wide range of adaptability (Mekonnen and Aticho, 2011). The tree species can be used for ornamental purposes, shade, shelter, tanning, oil, fuel wood, charcoal, timber, poles, posts, mine props, poly-wood, paper pulp, fiberboard, and as a source of nectar for honey production (Haileab, 2010). Because of its exceptional adaptability, rapid growth, and superior wood properties, Eucalyptus torelliana has been quickly adopted for plantation forestry in more than 100 countries (Pinto *et al*., 2016). The plant is helpful for treating minor aches and pains, food preservation, pharmaceuticals, and pesticides (Ololade and Olawore, 2013).

The tree species is used to treat gastrointestinal problems in Nigeria. A decoction of the leaves is also used to treat other bacterial infections of the respiratory and urinary tract and to treat sore throats (Alian*et al*., 2012; Farah *et al*., 2002). It has been discovered that the complementary application of organic fertilizers can improve yield stability and address any immediate soil nutrient deficits (Aluko *et al*., 2014). The physical, chemical, and biological characteristics of soils are greatly improved by organic materials, which also increase soil fertility and promote plant growth (Walen*et al*., 2001). There is little forestry knowledge that works against the development of this plant species' plantations, despite its potential and economic worth. This investigation was started to determine how organic fertilizers affected the Eucalyptus torilliana seedlings' ability to grow.

MATERIALS AND METHOD

The Study Area

The study was carried out at the Shabu-Lafia campus of Nasarawa State University's Department of Forestry and Wildlife Management in Lafia. The region is situated at an altitude of 177 m above sea level in the Guinea Savannah Zone of North Central Nigeria, between Longitude 080° 35' N and Latitude 080° 33' E. The range of the average monthly maximum temperature is between 35.06°C and 36.40°C, and the average monthly relative humidity is 74.67%, with 168.90mm of rainfall (Jayeoba, 2013). The research area's vegetation is characteristic of Nigeria's Southern Guinea Savannah Zone, which is characterised by tall, short, scattered trees with a grass undergrowth. The people's primary industries are farming, fishing, trading, government service, and hunting.



Map of Lafia L.G.A. Showing the Location of Forestry Nursery at Faculty of Agriculture, Shabu (Nasarawa State University)

Source: shape file of Nigeria, OpenAfrica, 2013 - 2021 Code for Africa, Mapped on QGIS Desktop (3.18.3) (2021).

Experimental design and treatment

At the Federal College of Forestry in Jos, Plateau State, ripe Eucalyptus torelliana seeds were collected. Four days of air drying the seeds in the pods before physically removing them. These seeds were planted in nine topsoil-filled germination boxes. Four treatments were used in the trial, which was set up using a completely randomized design (CRD). At four weeks following germination, 240 seedlings from each germination box were randomly chosen and transplanted into 20 cm 25 cm black polythene pots with 1000g of top soil gathered from Forestry Department teak plantations.Poultry manure and bovine dung were applied to the transplanted seedlings after two weeks of acclimatization (poultry manure 10 g, cattle dung 10 g, poultry manure + cattle dung 5 g, and control 0 g). The ring method was used to provide organic fertilizers to the seedlings that were housed in polythene pots. There are 60 experimental pots used in each treatment.

Data collection and Analysis

After being transplanted, the seedlings were given 14 days to get used to the fertiliser treatments before measurements of their characteristics, such as plant height, leaf count, leaf area, collar girth, leaf length, and leaf width, were obtained every two weeks. A ruler calibrated in centimeters was used to measure the height of the seedlings from the collar to the tip of the apical bud. The collar girth was measured with a vernier calliper. Each seedling used in the experiment had its leaves counted and properly recorded. A meter rule calibrated in centimeters was used to measure the length and width of the leaves. The means of the different treatments were separated using Duncan's Multiple Rang Test at $p < 0.05$ after the gathered data underwent an analysis of variance.

Plate1.*Eucalyptus torilliana* trees

Plate2. *E. torilliana* proceed seeds

Plate 3. *E. torilliana* Seeds sown in germination box

Plate 3. *E. torilliana* seedlings arranged according to treatments

RESULTS

The effect of organic fertilisers on the plant height of E. torilliana seedlings is depicted in Table 1. The results revealed no significant difference between the control and poultry manure ($p > 0.05$), however there were significant differences between the poultry manure and cattle dung ($p < 0.05$). The seedlings treated with poultry manure and cattle dung had the highest mean plant height (9.24±2.29a), while the seedlings treated with cattle dung had the lowest mean plant height (8.56±2.14b), which was obtained from the control.

Table 1: Influence of fertilizers on the plant height of *Eucalyptus torilliana* seedlings (cm)

Treatments	Plant height
Poultry manure + Cattle dung (5.0g + 5.0g)	9.24±2.29[a]
Control (0g)	7.85±1.89[c]
Cattle dung (10g)	8.56±2.14[b]
Poultry manure (10g)	7.88±2.23[c]
Mean	8.38±2.22

Mean on the same row with same alphabet are not significantly different at 0.05 levels; ns=not significant.

The results in table 2 showed that seedlings treated with poultry manure had the highest mean collar girth (2.05±0.35a), whereas seedlings treated with poultry manure+cattle dung had the lowest mean collar girth (1.88±0.36c). The outcomes also confirmed no changes between seedlings treated with cattle manure and the control ($p > 0.05$).

Table 2: Influence of fertilizers on the Collar Girthof *Eucalyptus torilliana* seedlings (mm)

Treatments	Collar girth
Poultry manure + Cattle dung (5.0g + 5.0g)	1.88±0.36[c]
Control (0g)	1.97±0.31[b]
Cattle dung (10g)	1.96±0.40[b]
Poultry manure (10g)	2.05±0.35[a]
Mean	1.97±0.36

Mean on the same row with same alphabet are not significantly different at 0.05 levels; ns=not significant.

The findings in table 3 showed that there were significant differences in the average number of leaves ($p < 0.05$). The seedlings treated with poultry manure + cattle dung had the highest mean number of leaves (9.65±5.62a), whereas the seedlings treated with cattle dung had the lowest mean number (7.51±3.48). The outcomes similarly revealed no differences between seedlings treated with poultry manure and those treated with cow dung ($p > 0.05$).

Table 3: Influence of fertilizers on the Number of leaves of*Eucalyptustorilliana* seedlings

Treatments	No. of leaf
Poultry manure + Cattle dung	9.65±5.62[a]
Control	9.09±2.79[b]
Cattle dung	7.51±3.48[c]
Poultry manure	7.60±2.66[c]
Mean	8.46±3.93

Mean on the same row with same alphabet are not significantly different at 0.05 levels; ns=not significant.

Table 4 displays the impact of fertilizers on the E. torilliana seedlings' leaf length. The seedlings treated with poultry manure + cattle dung had the highest mean leave length (4.79±1.39a), followed by the seedlings treated with cattle dung (4.49±1.37b), and the seedlings treated with poultry manure had the lowest mean leave length (4.71±1.59). Between seedlings treated with poultry manure + cattle dung and poultry manure, the results did not reveal any appreciable changes ($p > 0.05$).

Table 4: Influence of fertilizers on the mean Leave length of *Eucalyptus torilliana* seedlings (cm)

Treatments	Leave length
Poultry manure + Cattle dung	4.79±1.39[a]
Control	4.48±1.21[b]
Cattle dung	4.49±1.37[b]
Poultry manure	4.71±1.59[a]
Mean	4.62±1.40

Mean on the same row with same alphabet are not significantly different at 0.05 levels; ns=not significant.

According to the findings in table 5, seedlings treated with poultry manure + cow dung had the maximum mean leaf width (2.05±1.27a), while control seedlings had the lowest (1.79±0.59b). The outcomes also revealed no differences between seedlings treated with poultry manure, cow dung, and the control ($p > 0.05$).

Table 5: Influence of fertilizers on the mean leave width of *Eucalyptus torilliana* seedlings (cm)

Treatments	Leave Width
Poultry manure + Cattle dung	2.05±1.27[a]
Control	1.79±0.59[b]
Cattle dung	1.89±0.76[b]
Poultry manure	1.85±0.77[b]
Mean	1.89±0.89

Mean on the same row with same alphabet are not significantly different at 0.05 levels; ns=not significant.

The impact of fertilizers on the average leaf area of the seedlings is depicted in Table 6. The results showed that there were no differences between seedlings treated with cow dung and poultry manure ($p > 0.05$), but there were differences between seedlings treated with cattle dung plus poultry manure and the control ($p < 0.05$). The seedlings treated with poultry manure + cow dung had the highest mean leave area (10.72±8.03), whereas the control had the lowest mean leave area (8.61±4.52).

Table 6: Influence of fertilizers on the Mean Leave Areaof *Eucalyptus torilliana* seedlings (m^2)

Treatments	Leave Area
Poultry manure + Cattle dung	10.72±8.03[a]
Control	8.61±4.52[c]
Cattle dung	9.27±5.89[b]
Poultry manure	9.69±6.08[b]
Mean	9.57±6.29

Mean on the same row with same alphabet are not significantly different at 0.05 levels; ns=not significant.

Weekly growth variables are shown in Table 7. The results revealed a significant change in plant height between weeks 3 and 8 (10.10±1.83). Plant girth varied significantly ($p < 0.05$) from weeks 3, 4, 5, and 8, however there were no significant variations between weeks 6 and 7. No significant differences ($p > 0.05$) were seen between week 4 (9.24±5.75) and week 7 (9.16±5.85) in the results for leaf area. Week 8 had the largest mean leaf area (11.58±8.32), whereas week 3 had the lowest mean leaf area (8.31±5.58). According to the results of the leaf count, the week with the highest mean number of leaves (9.94±5.13) and the week with the lowest mean number of leaves (6.87±2.11) were both weeks.

Table 7: Mean value and Duncan mean separation value for growth variables on the basis weeks.

Weeks after planting	Plant height	Girth	No of leaf	Leaf Length	Leaf Width	Leaf Area
3	6.33±1.53^{f}	1.71±0.39^{e}	6.87±2.11^{d}	4.15±1.43^{d}	1.78±0.86^{b}	8.31±5.58^{c}
4	6.98±1.61^{e}	1.82±0.30^{d}	7.72±3.30^{c}	4.51±1.19^{c}	1.90±0.74^{b}	9.24±5.75^{b}
5	8.22±1.91^{d}	1.90±0.29^{c}	9.94±5.13^{a}	4.49±1.39^{c}	1.84±0.77^{b}	9.13±5.84^{b}
6	9.06±1.82^{c}	2.03±0.27^{b}	8.30±3.35^{b}	4.86±1.39^{b}	1.91±0.64^{b}	10.01±5.54^{b}
7	9.61±1.76^{b}	2.08±0.27^{b}	8.10±3.95^{b}	4.46±1.38^{c}	1.87±0.76^{b}	9.16±5.85^{b}
8	10.10±1.83^{a}	2.25±0.33^{a}	9.85±4.13^{a}	5.25±1.35^{a}	2.08±1.36^{a}	11.58±8.32^{a}
Mean	8.38±2.22	1.97±0.36	8.46±3.93	4.62±1.40	1.89±0.89	9.57±6.29

Mean on the same row with same alphabet are not significantly different at 0.05 levels; ns=not significant.

DISCUSSION

Based on the use of the treatment, E. torelliana seedlings responded strongly ($P < 0.05$). The maximum mean plant height (9.24±2.29) was observed in seedlings treated with cattle dung and poultry manure (5.0 g each). This might be the case since the addition of fertilizers increased the height of the seedlings. The findings were in line with the findings of (Craven *et al*., 2006; Gbadamosi, 2006), which said that a healthy seedling needs to be adequately provided with nutrients in the right quantities for effective growth. Similar result was found by (Focho*et al*., 2011), who reported that, when sufficient fertilizer is applied to seedlings, the yield is higher than when fertilizer is not applied.

According to results on collar girth, plants treated with poultry dung outperformed controls (untreated seedlings). On seedlings treated with poultry manure, the highest mean value (2.05±0.35) was observed, which was higher than that of the control. This is most likely caused by the concentrated nutrients found in poultry manure, which support plant growth. The quantity and quality of nutrients in poultry manure may be higher than in cow dung, which aided in the seedlings' growth. This concurs with the results of research conducted by Ajari*et al*. (2003) and Kuje*et al*. (2019), which revealed that, when compared to other sources of manure, poultry dung promotes seedling growth. The growth performance of some timber seedlings without fertilzer application was shown to be poor by Ong *et al*. in 2003.

There were changes in the number of leaves the seedlings produced that were significant ($p < 0.05$). The seedlings given the combination of poultry manure and cow dung had more leaves on average than the control (9.65±5.62). The findings indicate a substantial difference ($p<0.05$) between the treatments in seedling leaf area. In comparison to seedlings treated with cattle dung, poultry manure, and the control, seedlings treated with poultry manure + cattle dung had the largest (10.72±8.03) mean leave area. This might be the case because the growth of E. torelliana seedlings was accelerated by the application of both cattle dung (5.0g) and poultry manure (5.0g). This was in line with the conclusions of Ogunwale*et al.* (2002) and Kuje*et al.* (2019), who found that the addition of organic fertilizer improved the availability of nutrients to plants, particularly in tropical soils where soil organic matter is typically low.

Results on leaf width revealed that among the treatments, seedlings fed with poultry manure + cattle dung had the greatest mean value (2.05±1.27). This shows that there were differences between the treatments that were significant ($P < 0.05$). Similarly, seedlings fed with both cattle dung and chicken manure had the largest mean leaf length (4.79±1.39). This might be the result of the high nutrient content, particularly nitrogen, in cattle dung and poultry manure, which promoted the growth of the seedlings. This is also consistent with research from Seyedbagheri (1999) and Kuje*et al*. (2019), which found that organic fertilizer promotes the growth of seedlings. Results for the weekly seedling variables demonstrate that there were significant differences in plant height from weeks 3 (6.33±1.53) to 8 (10.10±1.83) but no significant differences in collar girth between weeks 6 (2.03±0.27) and 7 (2.08±0.27) ($P>0.05$). This outcome is consistent with research by Ufere*et al.* (2013), who found related results in their experiment.

CONCLUSION

Based on these results, it can be concluded that the use of organic fertilizers (poultry manure, cattle dung, and a mixture of poultry manure and cattle dung) improved *Eucalyptus toreliana* seedling growth performance in the study area. When compared to untreated seedlings, treated seedlings fared better. The best growth variables were produced by seedlings treated with poultry manure and cow dung, and the treatment with poultry manure was superior to the treatment with cattle dung. Therefore, it is recommended that, *E. toreliana* be produced at nurseries for plantation establishment with the application of poultry manure and cattle dung.

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