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Research Article

Comparative Study on the Effects of Organic fertilizer (Cow dung), Inorganic Fertilizer (N.P.K) and the Combined Effect of Fertilizers on the Growth Parameters of Strangler Fig (*Ficus thonningii*)

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ABSTRACT

A comparative study on the effect of organic manure (Cow Dung), inorganic fertilizer (NPK 15-15-15), and their combined effect on the growth of Strangler fig (*Ficus thonningii*) was carried out at Government Senior Secondary School Dawakin Tofa Local Government Area, Kano State, Nigeria for 28 weeks. The objective of this study was to determine and compare the effect of organic fertilizer (Cow Dung), inorganic fertilizer (N.P.K 15:15:15) and their combined effects on the growth of *Ficus thonningii* seedlings. The experiment was laid out in a Randomized Complete Block Design (RCBD) with five treatments and a control replicated four times. The treatments consisted of T_1= (15g NPK), T_2 = (15g CD), T_3 = (7.5g NPK: 7.5g CD), T_4 = (11.3g NPK + 3.7g CD), T_5 = (11.3g CD + 3.7g NPK) and a control (unfertilized) denoted as T_6. Various growth parameters such as plant height, number of leaves, plant girth, leaf size and number of branches per plant were measured at 2-week intervals for 7 months. All the data collected were subjected to a two-way analysis of variance (ANOVA) at $p<0.05$ level of significance using R-software. The results from the experiment showed that most growth characters measured were significantly affected by the application of sole cow dung (15g CD). Thus, based on results obtained in this study, it is suggested to use 15g sole of cow dung for optimum and better growth of *Ficus thonningii* seedlings in the study area.

Keywords: Organic manure; Inorganic fertilizer; Strangler fig; Plant growth

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INTRODUCTION

Strangler Fig (*Ficus thonningii*) called Chediya in Hausa, is one of numerous evergreen fruit-bearing trees belongs to Moraceae family that have been used for generations to treat various medical conditions in Africa and beyond (Schmidt *et al.,* 2002). It's a past growing and drought tolerance tree plant species (Balehegn *et al.,* 2014). *Ficus thonningii* have fluted or multi-stemmed trunk that grows to a height of 6-21 meters. The leaves are alternate or whorled, mid-dark green and sub-glossy above and paler below (Schmidt *et al.,* 2002). *Ficus thonngii* can be found in a variety of habitats, including upland forest, savannah, grassland, riverine and even rocky areas. The species is a native to Nigeria and other African nations. The plant also has a phytochemical composition and is used ethnomedically to cure a variety of illnesses, including diabetes, gonorrhea, malaria, diarrhea and many others (Njoronge & Kibunga, 2006). Fertilizers, both organic and inorganic, are necessary for plant growth, because they provide the nutrients that plants require to thrive at their best. However, the use of organic manure in conjunction with a chemical fertilizer boosts microbial

activity and improves nutrient utilization (Narwal & Chaudhary, 2006).

MATERIAS AND METHODS

Study site: The field experiment was conducted at Government Senior Secondary School Dawakin Tofa, located on the coordinates of longitude12^0 06'052" N and latitude 8^0 20'046" E in Dawaki town, Dawakin Tofa Local Government Area of Kano State, Nigeria. The area receives an average annual rainfall of 800 to 1000 mm, which typically lasts three (3) to five (5) months, and the average temperature ranges from 26^{0}C to 33^{0}C degrees Celsius (KNSG, 2014).

Seedlings and Fertilizers Sources: Healthy seedlings of *Ficus thonningii* plant were sourced from the Nursery Site Bokavu Barracks Katsina Road, Kano State. The species of *Ficus thonningii* was identified and confirmed at Vouchers Herbarium, Department of Plant Biology Bayero University Kano and given an accession number BUKHAN 110. The Cow dung was obtained from the livestock section of the Nana farm, located at Sarauniya village whereas the NPK (15:15:15) was obtained from an authorized dealer at Dawanau market, Dawakin Tofa Local Government Area, Kano State, Nigeria.

Soil Physicochemical and Organic Manure Analysis: before the beginning of the experiment, soil samples were taken from the profile at a depth of 0-190cm and then combined to create a composite sample. The physical characteristics of the soil such as texture, colour, consistency, structure, moisture content and porosity were determined to assess the physical quality of the soil. However, chemical characteristics of the soil were examined at the soil science laboratory of the Department of Soil Science, Faculty of Agriculture, Bayero University Kano. Available phosphorus was determine using Olsen method, the Kjeldhal method was used to determine the total nitrogen, and a pH meter was used to assess the soil's acidity or alkalinity. A flame photometer was used to measure sodium (Na) and potassium (K), while an atomic absorption spectrophotometer was used to estimate calcium (Ca) and magnesium (Mg) contents. The particle size distribution was determined using Bouyouncos hydrometer technique. Other chemicals properties observed were organic carbon, EC, etc. The chemical composition of the cow dung manure, including pH, EC, O.M., TN, and available P, K, Ca, and Mg, were also analyzed.

Experimental Design and Treatments Allocation: A Randomized Complete Block Design (RCBD) was adopted for this experiment with five (5) treatments with a control replicated 4 times, making a total of 4 plots, 24 seedlings per plot giving a total sum of 96 seedlings. The treatments used are T_1= 100% NPK (15g), T_2 = 100% Cow Dung (15g), T_3 = 50% NPK + 50% Cow Dung (7.5g + 7.5g), T_4 = 75% NPK+ 25% Cow dung (11.3g + CD 3.7g), T_5 = 75% Cow dung +25% NPK (CD 11.3g + NPK 3.7g), T_6 = Control (unfertilized) and all the treatments were applied 2 weeks after planting.

Plant Growth Analysis: Various growth and development parameters such as plant height, number of leaves, plant girth, leaf size and number of branches per plant were measured at two-week intervals up to 28 WAT (7 months). Plant height was measured using a metric ruler, stem girth was measured by measuring tape, and direct counting was used to ascertain the number of leaves and branches per plant, while a metric ruler was used to estimate the size of the leaves.

Statistical Analysis: Using the R software, the data on plant growth and development were subjected to two-way analysis of variance (ANOVA) at a 95% confidence level, as outlined by Snedecor and Cochran (1967). Duncan Multiple Range Test was used to separate significant differences between treatment means (Duncan, 1955).

RESULTS

The results showed that the soil is well drained with friable moist consistency and loose, soft when dry with an average bulk density of 1.61 cm3. The soil's texture was sandy clay loam (Scl). The soil has a moderate sub-angular blocky (Sbk) structure having a brown (10YR5/3b) colour (**Table 1**). The soil showed a pH of 6.99 (neutral), however, all other chemical characteristics examined were classified as moderate (**Table 1**). Different treatments of inorganic and organic fertilizers had a significant impact on the heights of *Ficus thonningii* seedlings, as shown in **Table 2**. *Ficus thonningii* plant height under all the treatments increased with time with a peak height at 28 weeks after transplanting (WAT). The highest mean number of 116.71± 10.00 was observed with T_2 treatment (15g CD) at 28 weeks after application while the least mean value of 79.45± 12.08 was recorded with T_6 (control). However, T_1 treatment (15g NPK), T_4 treatment (11.3g NPK + 3.7g CD) and T_5 treatment (11.3g CD + 3.7g NPK) were statistically similar ($p > 0.05$) but statistically different ($p < 0.05$) from T_3 treatment (7.5g NPK + 7.5g CD) and T_6 (control) using Duncan multiple range. **Table 3** shows the effects of cow dung, NPK 15:15:15 and combine treatments on the stem girth of *Ficus thonningii*. In all the treatments the highest mean value (9.01±1.01) was obtained from the seedlings subjected to T_2 treatment at 28 WAT whereas the lowest mean value (7.58± 0.8cm) was recorded in T_4 treatment at 28 WAT. There were no significant differences ($p>0.05$) between T_2 and T_1, T_3, and T_5 treatments, but there were significant differences ($p<0.05$) between T_2 and T_4, T_6

treatments. T_4 treatment, on the other hand, had no significant effect on stem girth ($p>0.05$) as compared to T_6 (control).

The results of the number of leaves are represented on **Table 4**. Among all the treatments, sole application of T_1 treatment (15g NPK) per plant generated the highest number of leaves throughout the period of measurement across the treatments. The highest mean value of 124.25± 12.28 was recorded from T_1 treatment at 28 WAT, while the least value of 66.50± 18.46cm was recorded from T_6 (control). Treatment one (T_1) significantly differed from all other treatments ($p<0.05$). However, T_4, T_5, T_2, and T_3 treatments were statistically similar ($p>0.05$), but significantly different ($p<0.05$) from T_6 control. Number of branches per plant as influenced by organic (cow dung) and inorganic (NPK 15:15:15) fertilizers and combined organic and inorganic amendment are presented on **Table 5**. Sole application of cow dung (T_2 treatment) was significantly ($p<0.05$) higher than all other treatments followed by T_5 treatment. The highest mean number of branches (6.62±0.50) was obtained from the T_2 treatment at 24WAT while the lowest mean number of branches (4.25±1.52) was obtained from the T_1treatment. However, at 16, 20, 24, and 28 weeks after transplanting, the difference between treatments on the number of branches per plant of *Ficus thonningii* was not significant ($p>0.05$). Between T_2 and T_5, there were no statistically significant differences ($p>0.05$), but differed significantly with other treatments ($p<0.05$).

Table 6 revealed the effects of cow dung, NPK 15:15:15 and combine treatments on the leave size of *Ficus thonningii*. The application of T_2 treatment substantially ($p<0.05$) increased the leaves sizes of *Ficus thonningii* compared to the other treatments. The leaves sizes of *Ficus thonningii* increased with time and the highest and the least mean values of 6.16 ± 0.53and 4.33± 0.47 were obtained at 28 weeks after transplanting (WAT) with seedlings subjected to T_2 treatment and T_6 (control). T_2 treatment differed significantly from the other treatments ($p<0.05$), though all treatments considerably increased the size of *Ficus thonningii* plant leaves as compared to the control treatment ($p<0.05$).

Table 1: Physicochemical Properties of the Soil at the Planting Site

Physical Properties	**Result**
Colour	10YR5/3b
Texture Class	Scl
Structure	Sbk
Sand (%)	75.3
Silt (%)	3.4
Clay (%)	21.4
BD (gcm3)	1.61
Note: b= brown; Scl= sandy clay loam; Sbk= Sub angular blocky; BD= Bulk density	
Chemical Properties	**Result**
pH	6.99
EC (ds/m)	0.051
OC (%)	1.1172
TN (%)	0.1017
P (mg/kg)	9.32
Ca cmol (+) kg-1	2.703
Mg cmol (+) kg-1	1.051
K cmol (+) kg-1	0.094
Na cmol (+) kg-1	0.298
Note: EC= Electrical conductivity, OC= Organic carbon, TN= Total nitrogen,	

Table 2: Effect of Fertilizers on the Height (cm) of *Ficus thonningii* seedlings

Variables	Duration						
Treatment	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks	28 weeks
T1	74.53±7.01^{a}	77.82±7.41^{ab}	82.57±8.31^{ab}	87.35±9.25^{b}	91.87±10.59^{b}	95.65±10.80^{b}	97.31±10.52^{b}
T2	78.03±8.07^{a}	81.16±8.12^{b}	88.56±8.77^{a}	96.79±9.12^{a}	103.41±9.49^{a}	110.46±10.06^{a}	116.71±10.00^{a}
T3	72.95±8.69^{a}	73.88±8.51^{ab}	76.49±8.86^{bc}	79.0±9.27^{c}	81.42±9.67^{c}	83.15±9.56^{c}	84.28±9.12^{c}
T4	75.90±9.86^{a}	79.13±9.77^{ab}	83.30±10.49^{ab}	87.42±11.08^{b}	91.26±11.54^{b}	94.60±11.85^{b}	96.81±12.01^{b}
T5	71.86±11.63^{a}	73.88±11.92^{ab}	80.01±12.34^{bc}	86.61±13.02^{b}	92.41±13.56^{b}	98.12±13.88^{b}	102.43±13.22^{b}
T6 (control)	71.57±10.31^{a}	72.29±10.70^{b}	73.85±10.63^{c}	75.65±10.64^{c}	77.18±11.37^{c}	78.87±11.99^{c}	79.45±12.08^{c}

Mean followed by superscript of different letters are significant at p<0.05; Interactions with *** are significant at p<0.05; T1= NPK (15g), T2= CD (15g), T3= NPK + CD (7.5g: 7.5g), T4= NPK + CD (11.3g: 3.7g), T5= CD + NPK (11.3g: 3.7g), T6= Control

Table 3: Effect of Fertilizers on the Stem girth (cm) of *Ficus thonningii* seedlings

	Duration						
Treatments	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks	28 weeks
T1	7.82± 1.35^{a}	7.83±1.35^{ab}	7.90±1.33^{a}	8.00±1.35^{ab}	8.09±1.34^{ab}	8.11± 1.36^{ab}	8.19± 1.41^{ab}
T2	6.68± 0.72^{b}	7.05±0.71^{bc}	7.37±0.69^{ab}	7.81±0.72^{ab}	8.33±0.87^{a}	8.62± 0.86^{a}	9.01± 1.01^{a}
T3	7.97± 1.39^{a}	7.97±1.39^{a}	8.05±1.37^{a}	8.11±1.33^{a}	8.19±1.33^{ab}	8.21± 1.35^{ab}	8.28± 1.32^{ab}
T4	6.78± 1.06^{b}	6.87±1.04^{c}	7.01±0.97^{b}	7.20±0.94^{b}	7.37±0.93^{b}	7.44± 0.92^{b}	7.58± 0.87^{b}
T5	6.85± 0.91^{b}	7.03±0.84^{bc}	7.24±0.79^{ab}	7.51±0.72^{ab}	7.81±0.63^{ab}	7.97± 0.58^{ab}	8.20± 0.67^{ab}
T6 (control)	7.78± 1.32^{a}	7.78±1.32^{ab}	7.85±1.30^{ab}	7.90±1.29^{ab}	7.97±1.29^{ab}	7.99± 1.29^{ab}	8.07± 8.07^{b}

Mean followed by a superscript of different letters are significant at p<0.05; Interactions with *** are significant at p<0.05; T1= NPK (15g), T2= CD (15g), T3= NPK + CD (7.5g: 7.5g), T4= NPK + CD (11.3g: 3.7g), T5= CD + NPK (11.3g: 3.7g), T6= Control

Table 4: Effect of Fertilizers on the Number of leaves of *Ficus thonningii* seedlings

Variables	Duration						
Treatments	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks	28 weeks
T1	66.12± 21.25^{a}	75.75±19.92^{a}	87.75±18.27^{a}	102.93±16.11^{a}	111.06±15.15^{a}	117.31± 13.0^{a}	124.25± 12.28^{a}
T2	68.31± 13.91^{a}	72.81±13.99^{a}	78.00±13.45^{ab}	84.18±14.35^{b}	86.93±13.93^{b}	89.75± 13.99^{b}	93.06± 12.76^{b}
T3	67.50± 19.17^{a}	69.93±19.61^{ab}	73.37±19.21^{bc}	77.43±18.80^{b}	78.25±18.73^{b}	78.81± 18.71^{b}	82.31± 18.34^{b}
T4	50.75± 19.34^{b}	58.12±19.28^{b}	65.68±20.09^{bc}	76.00±20.71^{bc}	82.37±22.10^{b}	86.56± 19.96^{b}	91.25± 20.02^{b}
T5	57.93± 14.30^{ab}	63.12±14.39^{ab}	69.18±15.33^{bc}	76.25±15.60^{bc}	79.50±14.39^{b}	83.25± 13.92^{b}	86.68± 13.49^{b}
T6 (control)	56.62± 19.55^{ab}	58.25±19.69^{b}	60.43±19.22^{c}	63.56±18.62^{c}	64.50±18.81^{c}	65.12± 18.44^{c}	66.50± 18.46^{c}

Mean followed by superscript of different letters are significant at p<0.05; Interactions with *** are significant at p<0.05; T1= NPK (15g), T2= CD (15g), T3= NPK + CD (7.5g: 7.5g), T4= NPK + CD (11.3g: 3.7g), T5= CD + NPK (11.3g: 3.7g), T6= Control

Table 5: Effect of Fertilizers on the Number of branches of *Ficus thonningii* seedlings

Variables	Duration						
Treatments	**4 weeks**	**8 weeks**	**12 weeks**	**16 weeks**	**20 weeks**	**24 weeks**	**28 weeks**
T1	2.87± 1.40^{ab}	3.06±1.56^{a}	3.93±1.56^{c}	4.25±1.52^{b}	4.25±1.52^{b}	4.25± 1.52^{b}	4.25± 1.52^{b}
T2	2.37± 0.50^{b}	3.75±1.39^{a}	5.50±0.89^{a}	5.93±0.77^{a}	6.56±0.51^{a}	6.62± 0.50^{a}	6.62± 0.50^{a}
T3	3.00± 0.89^{ab}	3.12±0.80^{a}	4.37±1.08^{bc}	4.50±1.03^{b}	4.50±1.03^{b}	4.50± 1.03^{b}	4.50± 1.03^{b}
T4	2.50± 1.26^{ab}	3.25±1.52^{a}	4.06±1.43^{c}	4.37±1.14^{b}	4.50±1.36^{b}	4.50± 1.36^{b}	4.50± 1.36^{b}
T5	3.00± 1.15^{ab}	3.68±1.53^{a}	5.18±1.37^{ab}	5.68±1.19^{a}	5.87±1.08^{a}	5.87± 1.08^{a}	5.87± 1.08^{a}
T6 (control)	3.25± 1.00^{a}	3.25±1.00^{a}	4.18±1.47^{c}	4.50±1.26^{b}	4.50±1.26^{b}	4.50± 1.26^{b}	4.50± 1.26b

Mean followed by superscript of different letters are significant at p<0.05; Interactions with *** are significant at p<0.05; T1= NPK (15g), T2= CD (15g), T3= NPK + CD (7.5g: 7.5g), T4= NPK + CD (11.3g: 3.7g), T5= CD + NPK (11.3g: 3.7g), T6= Control

Table 6: Effect of Fertilizers on the Leave size (cm) of *Ficus thonningii* seedlings

Variables	Duration						
Treatments	**4 weeks**	**8 weeks**	**12 weeks**	**16 weeks**	**20 weeks**	**24 weeks**	**28 weeks**
T1	4.44± 0.91^{ab}	4.73±0.97^{a}	4.85±0.98^{a}	5.06±0.99^{a}	5.11±1.00^{ab}	5.18± 1.00^{b}	5.25± 1.00^{b}
T2	3.91± 0.53^{b}	4.19±0.56^{b}	4.63±0.62^{ab}	5.30±0.58^{a}	5.57±0.55^{a}	5.81± 0.54^{a}	6.16± 0.53^{a}
T3	4.75± 0.53^{a}	4.77±0.51^{a}	4.85±0.50^{a}	5.00±0.55^{a}	5.03±0.54^{b}	5.06± 0.52^{b}	5.13± 0.52^{b}
T4	4.23± 0.92^{b}	4.37±0.88^{ab}	4.57±0.82^{ab}	4.86±0.84^{a}	4.98±0.82^{b}	5.08± 0.83^{b}	5.20± 0.82^{b}
T5	3.95± 0.63^{b}	4.13±0.63^{b}	4.42±0.63^{ab}	4.88±0.59^{a}	5.08±0.50^{ab}	5.26± 0.46^{b}	5.45± 0.46^{b}
T6 (control)	4.05± 0.47^{b}	4.06±0.45^{b}	4.11±0.47^{b}	4.19±0.53^{b}	4.20±0.54^{c}	4.26± 0.49^{c}	4.33± 0.47^{c}

Mean followed by a superscript of different letters are significant at p<0.05; Interactions with *** are significant at p<0.05; T1= NPK (15g), T2= CD (15g), T3= NPK + CD (7.5g: 7.5g), T4= NPK + CD (11.3g: 3.7g), T5= CD + NPK (11.3g: 3.7g), T6= Control

DISCUSSION

According to the recommendations of Esu, (1991); Robert (2004); NSFRM, (2005) & Crouse, (2018), the soil in the research area was not nutrients depleted, and possessed the required readily available nutrients needed for plant growth and development. However, just minor soil amendments were required to increase the quality and fertility of the soil to create a better growing environment for plants, and also for rapid growth and development of the transplanted seedlings. This was accomplished by using organic (cow dung), and inorganic (NPK 15-15-15) fertilizers and their combination (Cow Dung + NPK). The Cow dung used in this experiment also met the minimum standards for permissibility as a feasible fertilizer for plant growth and development (FAO, 1994). The increase in growth parameters of *Ficus thonningii* plant amended with organic (cow dung), inorganic (NPK 15:15:15), and their combination (Cow dung: NPK) fertilizers could be due to the release of nutrients aided plant growth and development by promoting efficient photosynthesis process (Iqtidar *et al.,* 2006). The results of this study revealed that the sole application of cow dung manure (15g CD) resulted in better performance on all growth variables measured, except on the number of leaves of the *Ficus thonningii* plant, which was better enhanced by the sole application of NPK 15-15-15 (15g NPK) as it generated the most leaves compared to other treatments. However, most treatments performed better than control over the experimental period. This finding is consistent with previous studies (Carl & Roger, 2005; Daniel & Obi, 2006; Osaigbovo *et al.,* 2010; Mukhtar's, 2016; Awosan *et al.,* 2018; Dachung & Kolu, 2019; Sodimu *et al.,* 2020). However, at 6 weeks after planting T_1 treatment (15g NPK 15:15:15) performed better on some growth variables (height, number of leaves, and leaf size) measured compared to other treatments. This could be a result of inorganic fertilizer dissolving quickly and supplying the immediate nutrition that plants require to thrive (Miller *et al.,* 2020). However, as the cow dung manure started to decompose in the latter (8–28) weeks, the seedlings treated 15g CD (T_2) grew more quickly than the seedlings subjected to 15g NPK (T_1).

The role of manure in supplying the major nutrients required for plant growth, such as N, P, K, and Ca, might be linked to the improved performance of *Ficus thonningii* as a result of cow dung application. Application of organic manures, such as cow dung is known to improve the overall soil physical conditions including soil moisture retention; they have a longer lasting effect on plant performance by releasing nutrients slowly and gradually over the course of a lengthy time which help soils build up organic matter, they also improve soil fertility status by activating the soil microbial biomass (Alleman *et al.,* 1996; Reyhan & Amisalani, 2006). Cow dung application increase soil organic matter, which improved soil structure and, at the same time, increased nutrient availability and other plant nutrients (Brar *et al.,* 2004; *Goss et al.,* 2013). Additionally, Akande *et al.,* (2008); Mehedi *et al.,* (2012) and Gudugi, (2013) depicted the same opinion that Cow manure improved plant growth and yield substantially.

CONCLUSION

From the result of this study, it can be concluded that both application of Cow dung and NPK (15: 15: 15) affected the growth of the *Ficus thonningi* plant. However, it is evident from the findings of this work that the sole application of Cow dung manure (15g CD) significantly enhanced the growth of *Ficus thonningii* seedlings on most of the growth parameters measured compared to the other treatments. Therefore, the sole application of 15g Cow dung manure may be the optimal fertilizer level for good growth of *Ficus thonningii* seedlings in the study area.

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