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Effect of cow dung and NPK fertilizer on the early growth of Northern Black Wattle (*Acacia auriculiformis* A. Cunn. ex. Benth) in Kaduna Northern Guinea Savanna Eco - zone of Nigeria

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ABSTRACT

During the early stages of plant growth, trees are very well dependent on soil nutrient supply, the soil has to be enrich with nutrients (Organic and inorganic) applications for optimal growth and development. This study was aimed at evaluating the effect of cow dung and NPK applications on *Acacia auriculiformis* at early growth stage to ascertain the best means of improving faster seedling growth of the species. The study was conducted in Savanna Forestry Research Station nursery situated in Institute for Agricultural Research (I.A.R) farm Samaru in Kurumi Bomu village. Seeds of matured *Acacia auriculiformis* were collected from plus tree at Savanna Forestry Research Station, Samaru – Zaria; Pre-treated with 50% of sulfuric acid (H_2SO_4) for 60 minutes to break the seed dormancy and sown directly in nursery pots filled with top soil, ten (10) potted seedlings were picked two (2) weeks after germination and divided into three (3) groups of three (3) different levels (3g; 6g and 9g) of cow dung and NPK (15:15:15) fertilizers. The experiment was laid out using Complete Randomized Design (CRD), ring method of fertilizers application were used. measured include seedling height; number of leaves and seedlings diameter the data was collected at 2WBFA, 4WAFA, 6WAFA and 8WAFA and subjected to analysis of variance and Duncan's Multiple Range Test (DMRT) at the end of the experiment the results show that application of cow dung at various doses significantly $P \leq 0.05$ yielded better growth and seedlings quality of Acacia auriculiformis as compared to NPK (15:15:15) fertilizer. NPK applied at 6 grams and 9 grams were significantly $P \leq 0.05$ toxic to the seedlings which led to high mortality rate after

application. However, from the results obtained in this experiment it was recommended that cow dung should be utilized to make nutrient available for optimal growth of *Acacia auriculiformis* seedlings and the application of NPK fertilizers above 3g on *Acacia auriculiformis* seedlings should be discouraged.

Key Words: Cow-dung, eco-zone, growth, NPK, Ring method

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INTRODUCTION

Northern black wattle, Ear-pod wattle, or Darwin black wattle ***(Acacia auriculiformis*** Cunn ex. Benth - (Family- Fabaceae) is a leguminous and multipurpose evergreen tree, which is found in many tropical zones of Southeast Asia, Africa and Latin America (Das & Alam, 2001; Simons & Leakey, 2004). It grows with a trunk up to 12 m long and 50 cm in diameter. It has dense foliage with an open, spreading crown. The trunk is crooked and the bark vertically fissured. Roots are shallow and spreading. Leaves 10-16 cm long and 1.5-2.5 cm wide with 3-8 parallel nerves, thick, leathery and curved. Flowers are 8 cm long and in pairs, creamy yellow and sweet scented. Pods are about 6.5 x 1.5 cm, flat, cartilaginous, glaucous, transversely veined with undulate margins (Tropical Plants Data Base, 2025). They are initially straight but on maturity become twisted with irregular spirals. Seeds are transversely held in the pod, broadly ovate to elliptical, about 4-6 x 3-4 mm (Amin *et al.,* 1995). The plant has a spreading, superficial and densely matted root system, which makes it suitable for stabilizing eroded land. Plantations of the tree improve soil physio-chemical properties such as water-holding capacity, organic carbon, nitrogen and potassium through litter fall. Its phyllodes provide a good, long-lasting mulch, the dense, dark-green foliage, which remains throughout the dry season, makes it an excellent shade tree. This plant species grows very fast, with the ability to fix nitrogen, thrive on infertile, acid, alkaline, saline and waterlogged soils (Hossain *et al.,* 1997). Successful use of *A. auriculiformis* in agro-forestry programme in Africa and Bangladesh has been reported owing to its rapid growth, short rotation and ability to thrive on degradable soil (Amin *et al.,* 1995). *A. auriculiformis* is a potential plant for erosion control, water conservation and also a source of biomass for fuel generation (Hossain *et al.*, 2009). The bark contains sufficient tannin (13 - 25%) for commercial exploitation, Bark harvested for its tannins should only be taken from mature stems, and only when the sap is rising at the beginning of the growing season - which is when the tannin content is highest and the bark is most easily removed from the wood, however, a natural dye, used in the batik textile industry in Indonesia, is also extracted from the bark (Orwa *et al.,* 2009). The heartwood

is light brown to dark red; it is demarcated from the yellow sapwood. The wood is hard, has a high basic density; is fine and straight-grained; often attractively figured; It is excellent wood for turnery articles, toys, carom coins, chessmen and handicrafts, it's also used for furniture, joinery, tool handles; and for construction if trees of suitable girth are available(Orwa *et al.,*2009). The wood is extensively used for paper pulp; Plantation-grown trees have been found promising for the production of unbleached Kraft pulp and high-quality, neutral, sulfite semi-chemical pulp (Orwa *et al.,* 2009). A major source of firewood, its dense wood and high energy (calorific value of 4500-4900 kcal/kg) contribute to its popularity; it provides very good charcoal that glows well with little smoke and does not spark (Hossain *et al.*, 2009).

A decoction of the root is used to treat aches and pains and sore eyes; an infusion of the bark has been used to treat rheumatism, the bark of all Acacia species contains greater or lesser quantities of tannins and are astringent; Astringents are often used medicinally - taken internally, for example, they are used in the treatment of diarrhea and dysentery, and can also be helpful in cases of internal bleeding and they applied externally, often as a wash, they are used to treat wounds and other skin problems, hemorrhoids, perspiring feet, some eye problems, as a mouth wash and so on (Orwa *et al.,* 2009). Many Acacia trees also yield greater or lesser quantities of a gum from the trunk and stems. This is sometimes taken internally in the treatment of diarrhea and hemorrhoids (Orwa *et al.,* 2009). However, to effectively harness the potentials of this species, emphasis must be made for improving their demand as plantation trees. In this regard, the use of organic (cow dung) and inorganic manure (NPK) applications becomes essential in forest soil management practice. In order to regenerate a forest and maintain it, the soil has to be enriched with nutrients. This enrichment could be in form of fertilizer application, which may be organic or inorganic forms, all of which furnish plants with nutrients necessary for their growth (Offiong *et. al.,* 2010; Eduardo *et. al.,* 2016; Sodimu et al., 2021). Siddhuraju (2007) and Sodimu *et. al.,* (2020) reported that during the early stages of growth, trees are very well dependent on soil nutrient supply. However, failure to manage nursery soil adequately can result in depletion of site quality and a reduction of seedling growth (Hoque *et. al.,* 2004; Sodimu *et. al.,* 2020) The dilemma for the foresters is therefor, how to increase the yield and quality of products for rapidly expanding wood based industries and for use by a rapidly expanding human population and simultaneously maintaining the environmental diversity. However, it is well understood that the loss of diversity may be minimized in a sustainable manner through increasing the number of species used in production forestry through

domestication of indigenous timber species (Rafiqul *et al.,* 2004). In view of this multipurpose function and utility of Black wattle (*Acacia auriculiformis*), it is favored for plantation programs. This study was aimed at evaluating the effect of cow dung and NPK applications on *Acacia auriculiformis* at early growth stage to ascertain the best means of improving faster seedling growth of the species.

MATERIALS AND METHODS

Study area

The study was conducted in Savanna Forestry Research Station nursery situated in Institute for Agricultural Research (I.A.R) farm Samaru in Kurumi Bomu village. Located at Latitude 12°13'and 11°11'N / Longitude 8°39' and 7°38' E and 686m above sea level (Figure 1). It is located in Sabon – Gari Local Government Area of Kaduna State. The vegetation in the local Government Area is the Northern Guinea Savannah woodland type, characterized by short scattered drought resistant trees with undergrowth of grass that serves as fuel for bushfires in the long dry season with mean annual rainfall of 1000mm – 1500mm, temperature of 25.6°C (78.1°F), precipitation of 1,117.6mm and humidity of 69% respectively (Sodimu *et al.*, 2021).

Seed treatment and experimental design

The pods of *Acacia auriculiformis* seeds were collected from Savanna Forest research station, Samaru Zaria. The seeds were extracted from the pods by soaking the pods in water for overnight to soften the coat and then wash in running water to remove the seeds. Seed dormancy was broken by soaking the seeds in 50 % concentration of H_2SO_4 acid for 60 minutes to rupture the hard coat and to enhance the germination of seeds. (Abubakar & Muhammed, 2013). The experiment was laid out in a Completely Randomized Design (CRD) with 2 (two) treatments (Cow dung and NPK) and three levels (3g; 6g and 9g) It was replicated 4 (four) times and a control

Seeds sowing and nutrient application

Treated seeds were sown directly into poly pots filled with sterilized river sand. Two (2) seeds were sown per poly pot, approximately 2cm deep into the pots. The seedlings were allowed for 2 (two) weeks growth before fertilizer application. *Acacia auriculiformis* seedlings were transplanted into poly pots filled with a mixture of top soil and river sand in ratio of 3:1 before the fertilizer application.

Both the cow dung and NPK fertilizers were applied when the seedlings were 2 (two) weeks old using ring method at varying levels of 3 g, 6 g and 9 g were administered into the poly pots.

Data collection and analysis

Observation were made and data were collected for the following early growth parameters; seedling height; diameter and number of leaves produced. The growth parameters were measured at two (2) weeks interval for eight (8) weeks. The height of seedling in each poly pot was measured using a graduated meter rule. Veneer caliper was used to measure the diameter of seedlings. The production of new leaves recorded by visually counting the number of leaves produced. These parameters were measured fortnightly. The data collected were Analyzed using Analysis of Variance (ANOVA) at $P \leq .0.05$ probability level and subjected to Duncan Multiple Range Test (DRMT).

RESULTS AND DISCUSSION

Table 1 shows the chemical analysis of cow dung and physiochemical properties of soil before the experiment. However, from the results the soil properties of the soil sample include sand (93.00%), stilt (1.70) and clay (6.44) this implies that the experimental soil is sandy hence coarse in texture. The experimental soil had a pH of 6.80 which indicates that the soil is neutral while the cow dung had pH of 8.68, which indicate alkalinity.

Seedlings height of *Acacia auriculiformis*

Table 2 shows varying effects of levels of Cow dung and NPK fertilizers applications on the mean height of *Acacia auriculiformis* seedlings. Highest mean height of 22.66cm was observed in the 6g treatment of Cow dung in the 8th week after application while NPK treatment recorded highest height of 19.15cm also at the 8th week after application. The lowest mean value of 0.00 was observed at 6^{th} and 8^{th} Weeks after planting in 6g and 9g dosage of NPK, respectively. However, there were negative responses of NPK fertilizers on survival of *Acacia auriculiformis* when the dosage was increased and this significantly increase the mortality rate at $P \leq 0.05$ when compare with the cow dung. Although, there were no significant difference $P \geq 0.05$ between the height in their initial height. This result is in accordance with the work of Ugese (2010) who observed that organic manure increases the growth of *Tamarindus indica.* The application of little doses

of fertilizer stimulates cell differentiation and multiplication leading to height increments (Afa *et al.,* 2011). Similar results have been reported for *Michelia champaca L* seedlings in which minimal doses of Phosphorus yielded positive effects on height increments (Hoque *et al.,* 2004). Although, high doses of phosphorus application may become toxic to seedlings since absorption of this element may affect regular metabolic processes (Ojeniyi, 2020).

Table 3 Shows effect of the varying levels of cow dung and NPK fertilizers on number of leaves of *Acacia auriculiformis.* Highest mean number of 20.41 was observed with 6g dosage of cow dung treatment in the 8th week after application while the NPK treatment with mean number of leaves of 16.10 recorded in the 8th week after application. Results indicated significant difference $P \leq 0.05$ in the number of leaves which showed increase through the study period.

Table1. Physiochemical properties of experimental soil and cow dung

Physical Properties	**Soil**	**Cow Dung**
Sand (%)	93.00	-
Silt (%)	1.70	-
Clay (%)	6.44	-
Chemical Properties		
pH	6.80	8.68
Elec.-cond.(ppm)	80.4	11970
Organic comp.(g/kg)	10.88	27.75
Organic manure(g/kg)	19.48	69.85
Available P (mg/kg)	41.16	0.129
Total N (g/kg)	0.38	0.74
Exchangeable Cations		
Na (mol/kg)	1.01	2.15
K (mol/kg)	0.41	2.01
Ca (mol/kg)	2.13	0.64
Mg (mol/kg)	10.53	0.153
E.A (mol/kg)	0.00	-
CEC (mol/kg)	14.48	-

There were negative responses of NPK fertilizers on number of leaves of *Acacia auriculiformis* when the dosage was increased (6g and 9g) and this significantly increase the mortality rate at $P \leq 0.05$ and causes burning of the leaves and the whole plant generally when compare with the cow dung. However, the above

finding agrees with the work of Ugese (2010) who obtained higher results in the number of leaves using organic manure on the growth of *Tamarindus indica.* Also, Mbah *et al.,* (2019) recorded better yield performance on crops planted with organic soil.

Table 2. Effect of varying level of Cow dung and NPK Fertilizers on the Mean Height (cm) of *Acacia auriculiformis* Seedlings

Treatment	2WBFA	4WAFA	6WAFA	8WAFA
Cow dung(3g)	10.55a	11.83a	18.31b	20.78c
Cow dung(6g)	10.30a	12.67a	19.90b	22.66c
Cow dung(9g)	11.42a	12.67a	18.71b	20.45c
NPK(3g)	11.44a	12.87a	16.32c	19.15
NPK(6g)	10.52a	11.26a	0.00	0.00
NPK(9g)	10.65b	9.74b	0.00	0.00
Control	-	13.78b	9.42a	9.45a
SE±	1.30	1.53	1.42	1.83

(i) Means in the same column followed by unlike letters are significantly different at
(ii) P≤.0.05 level of probability using Duncan's Multiple Range Test (DMRT)
(iii) WBFA=Weeks before fertilizers application.
(iv) WAFA= Weeks after fertilizers application

Table 3. Effect of varying level of cow dung and NPK fertilizers on the mean number of leaves of *Acacia auriculiformis* seedlings

Treatment	2WBFA	4WAFA	6WAFA	8WAFA
Cow dung(3g)	4.50a	9.04b	13.30a	20.51a
Cow dung(6g)	4.20a	8.63a	12.80a	20.41c
Cow dung(9g)	4.31a	8.95a	12.91a	17.80ab
NPK(3g)	6.00b	8.44a	13.68b	16.10b
NPK(6g)	4.10a	7.13a	0.00	0.00
NPK(9g)	4.50a	6.63a	0.00	0.00
Control	-	9.33b	9.60a	9.40b
SE±	0.84	0.98	1.40	2.6

(i) Means in the same column followed by unlike letters are significantly different at P≤0.05 level of probability using Duncan's Multiple Range Test (DMRT)
(ii) WBFA=Weeks before fertilizers application.
(iii) WAFA= Weeks after fertilizers application

Stem Diameter of *Acacia auriculiformis* Seedlings

Table 4 shows effect of the varying levels of cow dung and NPK on the mean girth of *Acacia auriculiformis* seedlings. Highest mean girth of 0.77cm was observed with 9 g dosage of cow dung treatment in the 6th week after application while the NPK treatment with mean diameter of 0.74cm in 3 g dosage recorded in the 6th week after application. The seedlings in this experiment were not significantlyP≥0.05 different in their initial diameter (at the time of fertilizer application).

Table 4. Effect of varying level of Cow dung and NPK fertilizers on the mean diameter (cm) of *Acacia auriculiformis* seedlings

Treatment	2WBFA	4WAFA	6WAFA	8WAFA
Cow dung(3g)	0.71a	0.72a	0.76a	0.76a
Cow dung(6g)	0.71a	0.71a	0.74a	0.76a
Cow dung(9g)	0.71a	0.72a	0.77a	0.77a
NPK(3g)	0.72a	0.72a	0.74a	0.75a
NPK(6g)	0.70a	0.71b	0.00	0.00
NPK(9g)	0.75b	0.60a	0.00	0.00
Control	-	0.71a	0.71a	0.71a
SE±	0.12	0.14	0.12	0.12

(i) Means in the same column followed by unlike letters are significantly different at P≤0.05 level of probability using Duncan's Multiple Range Test (DMRT)

(ii) WBFA=Weeks before fertilizers application.

(iii) WAFA= Weeks after fertilizers application

NPK applied at 6 g and 9 g were toxic to the seedlings which significantly P≤0.05 led to the high mortality rate in the treatment after application. NPK fertilizer have significant effect on diameter increment of *Acacia auriculiformis* seedlings and that after 6 weeks of application, there were no significant (P≥0.005) difference. This observation is in accordance with work of Rafiqul (2004) who recorded high performance of stem diameter in fertilizer application with *Anthocephalus chinensis.* Offiong *et al,* (2010); Mukhtar (2016) also recorded high performance of stem diameter in organic manure application with *Adansonia digitata* and *Tetrapleura tetraptera.*

CONCLUSION

It is an evident from the results that application of cow dung at various doses yielded better growth at the early stage of *Acacia auriculiformis* as compared to NPK fertilizers. Treatment with NPK was toxic to the seedlings at 6 g and 9 g levels of applications which led to the death of the seedlings.

RECOMENDATIONS

Based on the above results, it is therefore recommended that cow-dung should be utilized for better plant nutrition and faster growth of *Acacia auriculiformis* seedlings, and also, the application of NPK fertilizers above 3g, can affect the growth of *Acacia auriculiformis* seedlings negatively hence p roper application guidelines should be adhered to for optimum growth and development of the species.

AUTHORS' CONTRIBUTIONS

Akintunde Isiaka SODIMU: Investigation; data curation; writing-original draft; software / formal analysis; writing-review part, and editing.
Muhammed Fatima RASHEED: Conceptualization; validation,
David BAYO : Methodology, and editing

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