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Effect of Cowdung and NPK Fertilizer on the Early Growth of *Tamarindus indica. L* in Kaduna Northern Guinea Savanna Eco - Zone of Nigeria

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Abstract

The experiment was conducted at the Federal College of Forestry Mechanization, Afaka-Kaduna, nursery to determine the effect of cow dung and NPK (15:15:15) fertilizers on the early growth of *Tamarindus indica.* Seeds of matured *Tamarindus indica* were collected from plus tree at Trial Afforestation Project, Afaka-Kaduna. Pre-treated with 50% of sulphuric 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 and9g) of cowdung and NPK 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,6WAFAand 8WAFA and subjected to analysis of variance and Duncan's Multiple Range Test (DMRT)at the end of the experiment the results show that

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application of cowdung at various doses significantly (P>0.05) yielded better growth and seedlings quality of Tamarindus indica as compared to NPK (15:15:15) fertilizer. NPK applied at 6 grams and 9 grams were significantly (P>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 cowdung should be utilized to make nutrient available for optimal growth of *Tamarindus indica* seedlings and the application of NPK fertilizers above 3g on *Tamarindus indica* seedlings should be discouraged.

Keywords: Cowdung, Eco-zone, NPK, Growth, Ring Method.

1.0 INTRODUCTION

Tamarindus indica L., commonly known as Tamarind is one of the most important multipurpose fruit tree species in the tropical region. It is a large evergreen tree up to 30 m tall, bole usually 1-2 m, up to 2 m diameter, crown is dense, widely spreading, rounded; bark rough, fissured, grayish brown (Bhadoriya *et al.* 2011). *Tamarindus indica* belongs to the family *Fabaceae* and subfamily *Caesalpinioideae.* It is an important source of food in the tropics. It is a multipurpose tree of which almost every part finds at least some use as either nutritional or medicinal (Kumar and Bhattacharya, 2008). It is drought resistant and strong. It performs well as a wind break preventing soil erosion and protecting people, crops and animals in harsh environment (Christman, 2010). Tamarind is indigenous to tropical Africa but it has been introduced and naturalized worldwide in over 50 countries. The major production areas are in the Asian countries, India and Thailand, but also in Bangladesh, Sri Lanka, and Indonesia, while America, Mexico and Costa Rica are the biggest producers. (Imoro *et. al.,*2012) Africa on the whole does not produce tamarind on a commercial scale, though it is widely used by the local people. Minor producing countries in Africa are Senegal, Gambia, Kenya, Tanzania and Zambia (El-Siddig *et al.,* 2006; Ndubuaku *et. al.,* 2015). *T. indica* is a long lived, medium –growth bushy tree which attains a maximum crown height of 2.1 to 18.3 meters (40 to 60 feet).

The crown has an irregular vase shaped outlines of dense foliage. The tree grows in full sum in clay, loam, sandy and acidic soil types, with a high drought and aerosol salt (wind-born salt as found in coastal areas) resistance. The tamarind does flower, though inconspicuously, with red and yellow elongated flowers. Flowers are 2.5cm wide (one inch), five petalled, born in small racemes, and yellow with orange or red streaks (Khanh, 2018). The tree is an indehiscent legume, sometimes called a pod, 12 to 15cm (3 to 6 inches) in length, with a hard brown shell. The fruit has a fleshy, juicy, acidulous pulp. It is mature when the flesh is colored brown or reddish brown. *Tamarindus indica* has a hard and heavy wood for general carpentry, boat building, firewood, and charcoal production; it is used as shade, amenity, bee forage and windbreak. Pods contain 1-10 seeds, which are irregularly shaped, flattened or rhomboid. Seeds are very hard, shiny, reddish, or purplish brown. They are embedded in the pulp, lined with a tough parchment resembling a membrane, and joined to each other with tough fibres (Kumar and Bhattacharya, 2008; Khanh,2018) The tamarind of Asia have longer pods containing 6 to 12 seeds, whereas African and west Indian varieties have short pods containing 1 to 6 seeds. The seeds are somewhat flattened and glossy brown (Ndubuaku *et al.,* 2015). Tamarind is valued highly for its fruits, especially the pulp which is used for a wide variety of domestic and industrial purposes especially for food and beverages (Kotecha and Kadam, 2003).

The pulp constitutes 30-50% of the ripe fruit, the shell and fibre account for 11-30% and the seed about 25-40% (El-Siddig *et al*., 2006). Tamarind fruit pulp is used for seasoning as a food component, to flavour confections, curries and sauces, and is a main component in juices and certain beverages. Tamarind fruit pulp is eaten fresh and often made into a juice, infusion or brine and can also be processed into jam and sweets. (El-Siddig *et al.,* 2006; Eduardo *et. al.,* 2016) The refreshing drinks are popular in many countries around the world, though there are many different recipes. In some African countries, the juice obtained from the fruit pulp is mixed with wood ash to neutralize the sour taste of the

tartaric acid. However, the most common method is to add sugar to make a pleasantly acid drink. Sometimes pulp is fermented into an alcoholic beverage (El-Siddig *et al.,* 2006; Ndubuaku *et. al.,*2015) There are great differences and variations in fruit size and flavour, tamarind seed is a by-product of the tamarind pulp industry. The presence of tannins and other dyeing matter in the testa make the whole seed unsuitable for direct consumption. The major industrial product of tamarind seed is the tamarind kernel powder (TKP) which is an important sizing material used in the textile, paper, and jute industries (Kumar and Bhattacharya, 2008). Flour from the seed may be made into cake and bread; Roasted seeds are claimed to be superior to groundnuts in flavour (ICRAF, 2007). Tamarind seed is also the raw material used in the manufacture of polysaccharide (jellose), adhesive and tannin. In 1942, two Indian scientists observed that decorticated kernels contained 46-48% of a gelforming substance. This polysaccharide (pectin) with carbohydrate character and gelly forming properties, named 'jellose' (El-Siddig *et al.,* 2006), has been recommended for use as a stabiliser in ice cream, mayonnaise and cheese, and as an ingredient or agent in a number of pharmaceutical products (Morton, 1987; El-Siddig *et al.,* 2006). In view of the overall nutrient and chemical composition, tamarind seeds may be adopted as an inexpensive alternative protein source to alleviate protein malnutrition among traditional people living in developing countries (Siddhuraju *et al.,* 1995). Tamarind leaves and flowers can be eaten as vegetables and are prepared in a variety of dishes (ICRAF, 2007). They are used to make curries, salads, stews and soups in many countries, especially in times of scarcity (El-Siddig *et al.,* 2006). Tamarind barks and leaves contain tannins. The bark is rich in tannins reaching up to 70%, and as such has found a place for use in the tanning industry. The bark is used for tanning hides and in dyeing (Morton, 1987; El-Siddig *et al.,* 2006). In Zambia, bark tannins are used in the preparation of ink and for fixing dyes. The bark is also burnt to make ink in many other African countries. Tamarind twigs are sometimes used as chewing sticks whereas the bark is used as a masticatory, alone or as a substitute of lime in betel nut. The bark yields

the alkaloid hordenine (Morton, 1987; El-Siddig *et al.,* 2006). The tamarind is best described as sweet and sour and high in acid, sugar, B vitamins and interestingly for a fruit, calcium. As tropical species it is frost sensitive(Khanh,2018).

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). 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 *Tamarindus indica*, it is favoured for plantation programs. This study was aimed at evaluating the effect of cowdung and NPK applications on *Tamarindus indica* at early growth stage to ascertain the best means of improving faster seedling growth of the species.

2.0 MATERIALS AND METHODS

2.1 Study Area:

The experiment was conducted at the nursery of Federal College of Forestry Mechanization, Afaka – Kaduna. It is located at 644m above sea level on latitude 10^0E

37^{1}N and 10^{0} 41^{1}N and longitude 7^{0} 47^{1}E Northern Guinea Savannah Ecological Zone of Nigeria (Otegbeye *et. al.,*2001). The soil in the College nursery is of the sandy loam textural class and slightly acidic. (Sodimu, *et. al.,*2020)

2.2 Seeds Collection and Treatment

The pods of Tamarindus indica seeds were collected from Trial Afforestation project plantation, Afaka-Kaduna. 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 and Muhammed,2013).

2.3 Experimental Design

The experiment was laid out in a Completely Randomized Design(CRD) with 2 (two) treatments (Cowdung and NPK) and three levels (3g; 6g and 9g) It was replicated 4 (four) times and a control.

2.4 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 seeds were lightly covered with sand and watering was done twice a day (Morning and evening) until the seeds start to germinate. The seedlings were allowed for 2 (two) weeks growth before fertilizer application. Tamarinds 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.

2.5 Data Collection Procedure

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. Vernier 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.

2.6 Data Analysis

The data collected were Analyzed using Analysis of Variance (ANOVA) at P>.0.05 probability level and subjected to Duncan Multiple Range Test (DRMT).

3.0 RESULTS AND DISCUSSION

3.1 Seedlings Height of Tamarindus indica:

Table 1 shows varying effects of levels of cowdung and NPK fertilizers applications on the mean height of *Tamarindus indica* seedlings. Highest mean height of 23.65cm was observed in the 6g treatment of cowdung in the 8th week after application while NPK treatment recorded highest height of 20.17cm also at the 8th week after application. The lowest mean value of 0.00 was observed at 6th and 8th Weeks after planting in 6g and 9g dosage of NPK respectively.

Table 1: Effect of Varying level of Cowdung and NPK Fertilizers on the Mean Height(cm) of *Termarindus indica* Seedlings:

Treatment	2WBFA	4WAFA	6WAFA	8WAFA
Cowdung (3g)	10.65a	11.81a	18.11b	21.77c
Cowdung (6g)	10.40a	12.65a	19.90b	23.65c
Cowdung (9g)	11.52a	12.65a	18.81b	22.43c
NPK(3g)	11.54a	12.85a	16.12c	20.17
NPK(6g)	10.62a	11.24a	0.00	0.00
NPK(9g)	10.75b	9.72b	0.00	0.00
Control	-	13.76b	9.22a	9.16a
SE±	1.30	1.53	1.42	1.83

(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*

However, there were negative responses of NPK fertilizers on survival of *T. indica* when the dosage was increased and this significantly increase the mortality rate at (P>0.05) when compare with the cowdung. Although, there were no significant difference (P>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 *T. 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.

3.2 Number of Leaves:

Table 2 Shows effect of the varying levels of cowdung and NPK fertilizers on number of leaves of *Tamarindus indica*. Highest mean number of 20.31 was observed with 6g dosage of cowdung treatment in the 8th week after application while the NPK treatment with mean number of leaves of 16.00 recorded in the 8th week after application. Results indicated significant difference (P>0.05) in the number of leaves which showed increase through the study period.

Table 2: Effect of Varying level of Cowdung and NPK Fertilizers on the Mean Number of Leaves of *Termarindus indica* Seedlings:

Treatment	2WBFA	4WAFA	6WAFA	8WAFA
Cowdung (3g)	4.80a	9.01b	13.10a	20.41a
Cowdung (6g)	4.50a	8.60a	12.50a	20.31c
Cowdung (9g)	4.61a	8.92a	12.81a	17.70ab
NPK(3g)	6.30b	8.41a	13.38b	16.00b
NPK(6g)	4.40a	7.10a	0.00	0.00
NPK(9g)	4.80a	6.60a	0.00	0.00
Control	-	9.30b	9.30a	9.30b
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

There were negative responses of NPK fertilizers on number of leaves of *T. indica* when the dosage was increased (6g and 9g) and this significantly increase the mortality rate at (P>0.05) and causes burning of the leaves and the whole plant generally when compare with the cowdung 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.*

3.3 Stem Diameter of *Tamarindus indica* Seedlings

Table 3 shows effect of the varying levels of cowdung and NPK on the mean girth of *Tamarindus indica* seedlings. Highest mean girth of 0.57cm was observed with 9 g dosage of cowdung treatment in the 6th week after application while the NPK treatment with mean diameter of 0.54cm in 3 g dosage recorded in the 6th week after application. The

seedlings in this experiment were not significantly(P>0.05) different in their initial diameter (at the time of fertilizer application).

Table 3: Effect of Varying level of Cowdung and NPK Fertilizers on the Mean Diameter (cm) of *Termarindus indica* Seedlings:

Treatment	2WBFA	4WAFA	6WAFA	8WAFA
Cowdung (3g)	0.51a	0.52a	0.56a	0.56a
Cowdung (6g)	0.51a	0.51a	0.54a	0.56a
Cowdung (9g)	0.51a	0.52a	0.57a	0.57a
NPK(3g)	0.52a	0.52a	0.54a	0.55a
NPK(6g)	0.50a	0.51b	0.00	0.00
NPK(9g)	0.55b	0.40a	0.00	0.00
Control	-	0.51a	0.51a	0.51a
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 *Tamarindus indica* 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.*

4.0 CONCLUSION AND RECOMENDATION

4.1 Conclusion

It is an evident from the results that application of cowdung at various doses yielded better growth at the early stage of Tamarindus indica 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.

4.2 Recommendation

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

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