Original Research Article

Effects of Inorganic Fertilizer Application on Plant Growth of *Vitellaria paradoxa*

Abstract~~s~~

Declining soil fertility is a main reason for the slow growth in food production in Africa. However, the practices of incorporating fertilizers could potentially improve soil fertility and productivity. This experiments was carried out to determine the efficacy of inorganic fertilizer on the growth performance of *Vitellaria paradoxa* ~~(*V. paradoxa*)~~ under a greenhouse condition was set up at the Department of Forestry Technology, Federal College of Forestry Ibadan located within the government Reserve Area (GRA) Jericho Ibadan. The experimental design was a Completely Randomized Design (CRD) having sixteen treatments with four (4) replicates each, making a total of 64 experimental samples. Different fertilizer types (Urea and NPK) were used with their combination and ~~Control~~ control (no fertilizer). Data on plant height, number of leaves, collar diameter and leaf area, were generated and subjected to analysis of variance and significant means separated using Duncan's Multiple Range Test at 5 % level of significance. The results showed that application of inorganic fertilizer at any rate produces higher growth in plant height and ~~Collar~~ collar diameter, than the control pot. ~~Application of different rates of fertilizer on number of leaves are comparable with the control.~~ However, there was no appreciable variation in all fertilizer rates, the highest values was obtained with the ~~Combination~~ combination of NPK and urea at 150/100ppm for plant height, number of leaves and leaf area; while the application of NPK/Urea: 150/150ppm produced the highest collar diameter. Further studies are recommended to validate the fertilizer requirements of the plant species.

Keywords: Growth, Urea, NPK, *Vitellaria paradoxa*, inorganic fertilizer application

Introduction

The semi-domesticated shea butter tree *Vitellaria paradoxa* f~~(*V. paradoxa*) F~~amily Sapotaceae is wildly distributed in the Sudano-Sahalian, region from Senegal to Uganda (Hall et al., 1996; Salle et al., 1991). Presently two subspecies have been identified. *V. paradoxa* subsp. *paradoxa* is found in West and Central Africa (Hall *et al*., 1996; Salle *et al.*, 1991; Allal *et al*., 2008; Kelly *et al*., 2004), while *V. paradoxa* subsp. *nilotica* is common in East Africa such as Soudan, Ethiopia, Uganda and Republic Demotratic of Congo, (~~-~~Byakagaba *et al*., 2011; Okiror *et al*., 2012). Various environmental factors influences the tree shape and it is identified by farmers according to the folk classification. In wet season, the tree produces fruits edible by both animals and human being. The fruits contains 1 to 3 large solitary seeds, rich in fat and oil used in a

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variety of purposes such as cooking (Abbiw, 1990), medicinal, hair and skin ointments and as a base for industrial manufacture of confectioneries (Cidell and Alberts, 2006). The oil is also used in traditional and social rituals such as marriages, funerals, coronations and rainmaking (Ferris *et al*., 2004; Hall *et al*., 1996; Moore, 2008).

Inorganic and organic fertilizers are essential for plant growth. Both fertilizers supply plants with the nutrients needed for optimum performance. Organic fertilizers have been used for many centuries, whereas chemically synthesized inorganic fertilizers, were only widely developed during the industrial revolution. Inorganic fertilizer has significantly supported global population growth, it has been estimated that almost half the people on the earth are currently fed as a result of artificial nitrogen fertilizer use (Erisman *et al*., 2008). But, c~~C~~ommercial and subsistence farming has been and is still relying on the use of inorganic fertilizers for growing crops (Masarirambi *et al*., 2010). This is because they are easy to use, quickly absorbed and utilized by crops. The continued dependence of developing countries on inorganic fertilizers has made prices of man agricultural commodities to sky rock. The chemical fertilizers used in conventional agriculture contain just a few minerals which dissolve quickly in damp soil and give the plants large doses of minerals (Masarirambi *et al*., 2010). Therefore this research focused on the influence of various types of inorganic fertilizer on the early growth of ~~performance of~~ *V.~~itellaria~~ paradoxa* ~~(V. paradoxa)~~.

2.0 MATERIALS AND METHODS

2.1 Experimental site

The experiment was carried out in Federal College of Forest, Ibadan located within the government Reserve Area (GRA), Jericho Ibadan and South-West local Government area of Oyo state. It lies on latitude $7^0 90^{'}$N and longitude $3^0 54^{'}$E, the climate pattern of the area is tropically dominated by annual rainfall which ranges from 1,200-1,250 mm and average relative humidity of about 37.2^0C. The eco-climate of the dry season (usually commencing from November-March) and the raining season start from April to October (FRIN, 2016).

2.2 Procurements of materials

Soil samples was collected from farm practical area (FAP), Federal College Forestry, Ibadan. Top soil of 0 – 20 cm depth was used for the experiment. The soil was air dried; grounded and sieved using 2 mm sieve to remove gravel and large plant roots. The soil samples were chemically analyzed ~~for nitrogen and other nutrient content~~. Four kilogram (4kg) soil was weighed in a polythene bag. Seedlings of ~~(~~*V. paradoxa*~~)~~ were collected from the mother tree and raised in a germination, basket for four (4) weeks, 64 healthy seedlings was selected from the basket based on the uniform treatments and then transplanted into a 4kg pot of ~~-~~soil. F~~, F~~ertilizer types were added after transplanting and stabilization of the plants in a ring application. Watering was done regularly and data collection was taken every three (3) weeks on ~~Plants~~ plants height, ~~Collar~~ collar diameter, ~~Number~~ number of leaves and leaf area for a period of 20 weeks. The experimental design was a Completely Randomized Design (CRD) with sixteen treatments (16) and four (4) replicates each making a total of 64 experimental samples. Treatments used were ~~Urea~~ urea at three (3) levels; 50 mg ~~/~~kg^{-1}, 100 mg kg^{-1}~~mg/kg~~ and 150 mg kg^{-1}~~mg/kg~~: and NPK (15:15:15) at three levels; 50 mg kg^{-1}~~mg/kg~~, 100 mg kg^{-1}~~mg/kg~~ and 150 mg kg^{-1}~~mg/kg;~~ combination of Urea + NPK and ~~Control~~ control (~~No~~ no amendments).

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2.3 Data collection

The following growth parameter of *V. paradoxa* was taken

i) Plant height
ii) Number of leaves
iii) Collar diameter
iv) Leaf Area

2.4 Soil Laboratory analysis

Pre-planting soil was analyzed for the essential elements (~~Macro~~ macro and ~~Micro~~ micronutrients). Soil pH was determined in 1:1 soil-water suspension~~;~~, organic carbon (OC) by Walkley-Black oxidation method; ~~Total~~ total nitrogen (N) by micro-~~-~~Kjeldahl distillation method~~;~~ available P by Bray 1 method; exchangeable K and Na by the flame photometer method~~;~~ Ca and Mg by EDTA titration method. Particle size analysis was done using

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hydrometer method. The analyses were carried out at Soil and Tree Nutrition Laboratory, Bioscience Department Ibadan.

2.5 Statistical analysis

Quantitative data will be analyzed using the ANOVA procedure and means separated using the Duncan Multiple Range Test (DMRT) at 5% probability (SAS Institute, 2002).

3.0 Results and Discussions

3.1 Physicochemical ~~Characteristics~~ characteristics of ~~Soil~~ soil

The pre-cropping soil recorded 5.9 pH in H_2O (1:1). T~~,~~ ~~t~~he surface soil is sandy loam with 792 g kg^{-1} sand~~;~~ 124 g kg^{-1} clay~~;~~ 84 g kg^{-1} silt~~;~~ 1.18 % organic carbon (OC)~~;~~ 0.22 % N~~;~~ 15.13 mg kg^{-1} available P~~;~~ 0.32 $cmol_c$ kg^{-1} K~~;~~ 0.25 $cmol_c$ kg^{-1} Ca~~;~~ 2.1 $cmol_c$ kg^{-1} Mg~~;~~ 1.86 $cmol_c$ kg^{-1} Na~~.~~ (Table 1).

Table 1. Physical and chemical properties of the pre cropping soil

Properties	Soil values
pH H_2O (1:1)	5.9
Sand g kg^{-1}	792
Silt g kg^{-1}	84
Clay g kg^{-1}	124
Textural Class	Sandy loam
O.C %	1.18
N %	0.22
Available ~~Phosphorus~~P	15.13
Exchangeable bases ~~Cmol~~$cmol_c$ ~~/~~kg^{-1}	
K	0.32
Mg	2.1
Ca	0.25
Na	1.86

Table 2: Influence of fertilizer types on plant height, stem diameter, number of leaves and leaf area of ~~(~~*V. paradoxa*~~)~~

Fertilizer Types (ppm)	Growth Parameter			
	Plant Height (cm)	Stem Diameter (mm)	Number of Leaves	Leaf Area (cm^2)
No fertilizer (Control)	12.65a	4.51a	4.97a	49.23a

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Urea:50ppm	13.22abc	4.54a	4.97a	50.36ab
Urea:100ppm	13.34abc	4.54a	5.00a	50.89ab
Urea:150ppm	12.88ab	4.56a	4.99a	50.70ab
NPK:50ppm	13.65abc	4.59a	4.98a	50.74ab
NPK/Urea:50/50ppm	13.75abc	4.64a	5.02a	51.14ab
NPK/Urea:50/100ppm	13.97abc	4.69a	5.04a	52.37bc
NPK/Urea:50/150ppm	14.02abc	4.76a	4.97a	53.15bc
NPK:100ppm	14.26abc	4.79a	4.97a	53.20bc
NPK/Urea:100/50ppm	13.88abc	4.77a	5.02a	54.15e
NPK/Urea:100/100ppm	14.22abc	4.86a	5.11ab	54.35e
NPK/Urea:100/150ppm	14.24abc	4.91a	5.15ab	54.57e
NPK:150ppm	14.15abc	4.95a	5.17ab	54.80e
NPK/Urea:150/50ppm	14.31abc	4.95a	5.25ab	54.07e
NPK/Urea:150/100ppm	14.82ab	5.16a	5.64c	53.96e
NPK/Urea:150/150ppm	14.51bc	5.27a	5.20ab	53.79e

Mean Value±SE; number with different alphabet in column are significant different (P≤0.05)

Results as presented in Table 2 revealed that, there was no significant response among all fertilizers used in respect to the plant height. Combination of NPK and urea at 150/100ppm produced the highest height with mean value 14.82cm as compared with the control which recorded the least with 12.65cm. Hence, all other treatments are comparable to one another as much difference was not recorded among them. This shows the importance of ~~nitrogen~~ N for the growth of the plant, which is in agreement with the report of Tisdale et al. (2003) who showed that N is necessary for most physiological growth and its absence or deficiency causes stunted growth Fashina et al. (2002). There was increase response of plant height with increase in the combined doses of fertilizers and the sole application. Paul and DrisColl (1997) observed that the primary target of N limitation is the growing meristem of the plant and decreased rate of photosynthetic activity, which can be attributed to reduction in plant heights under N deficiency. This could explain the reason for the lowest value obtained in the control pot.

The stem girth was not influenced by all the treatments used. However, most inorganic fertilizers applied (Sole and combination) increases the stem girth of *V .paradoxa*. The highest stem girth was observed with the application of NPK/Urea: 150/150ppm recording a mean value of 5.27mm, while the lowest was obtained in the control plot with mean value of 4.51mm. The application of urea at 50ppm, 100ppm and 150ppm are comparable with the control as there was no variation when compared together.

The addition of ~~(~~NPK/Urea150/100ppm~~)~~ was significantly different from other treatments used. The highest number of leaves was recorded when NPK/Urea: 150/100ppm was applied, with a mean value of 5.64. W~~–w~~hile the least number of leaves was observed with the control (no application) Urea 50ppm, NPK:100ppm and NPK/Urea:50/150ppm with mean value of 4.97.

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Sole application, combined application as well as the control are relatively comparable with one another. This result is in line with Akinrinde (2006) that showed significant response of various crop species to the application of inorganic fertilizers. The results of the analyses of variance on the number of leaves showed that the effect of fertilizer application was significant on leaf production at the end of the experiment.

There was significant difference among all treatments used in the leaf area (cm^2). The highest leaf area was recorded with NPK/Urea: 150/100ppm having a mean value of 50.96cm^2, when compared with the control ~~that had the least with mean value of~~ (49.23cm^2). T~~,~~ the control pot was significantly different from pots that received ~~various~~ combination of fertilizers (Urea + NPK) and sole application of NPK at 100ppm.

Conclusion

Inorganic fertilizer application had no significant effects on *V.paradoxa*, as the lowest values of the measured parameters were obtained with no fertilizer application throughout the periods of evaluation with fertilizer rates of NPK/Urea:150/100ppm. ~~r~~Resulting in significantly higher values of the measured parameters in this study. Therefore, from the results of this study, application of NPK and urea at 150/100 could be considered for optimum growth of *V.paradoxa*. More studies are recommended to further evaluate the effects of inorganic fertilizers at various application rates on *V.paradoxa* for optimum growth.

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