Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension
Volume 21 Number 1 (January 2022) pp. 117 - 120

ISSN 1119-7455

Short Communication

INFLUENCE OF UREA FERTILIZER ON EARLY GROWTH OF AFRICAN ROSE WOOD (Pterocarpus *erinaceous Poir.*) SEEDLINGS IN KADUNA STATE, NORTHERN NIGERIA

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ABSTRACT

Influence of urea fertilizer on early growth and development of Pterocarpus erinaceous seedlings were investigated. Two hundred (200) uniformly growing seedlings were transplanted into polythene pots filled with top soil. Four urea fertilizer rates (0.035; 0.065; 0.095; 0.0125 g) and control were applied to the seedlings in the pots 20 × 25 × 25 cm, filled with 800 g of top soil collected from forest plantation. Assessment on the metrical character of the seedlings was done fortnightly. The fertilization of the selected seedlings with urea fertilizer was done round the seedlings in the nursery pots using ring method. The experiment was laid out in a completely randomized design. The data were subjected to analysis of variance, and means were separated using Duncan's multiple range test at $p < 0.05$. The results show that fertilizer rates had significant ($p < 0.05$) effect on the growth and development of seedlings of P. erinaceous. Seedlings treated with 0.095 g of urea produced the highest mean values of 12.00 ± 0.66 cm; 0.33 ± 0.01 mm; 190 cm^2 and 12.65 ± 0.67 for stem height, collar diameter, leaf area (LA) and number of leaves respectively. Seedlings fed with 0.125 g had the lowest values of 11.19 ± 0.61cm for height, 0.32± 0.01 mm for collar diameter 11.54 ± 0.70 for number of leaves and 124 cm^2 for the LA. Urea fertilizers had significant effect on the early growth of the seedlings, therefore fertilization at 0.095 g per pot is recommended for raising P. erinaceous seedlings.

Key words: seedling, growth and development, urea fertilizer, *Pterocarpus erinaceous*

INTRODUCTION

Populations of several woody plant species are under threat due to overexploitation causing habitat degradation by intensification of grazing, illegal forest logging and so on (Vallejo, 2009; Lafortezza *et al.,* 2013). This situation impacts seed banks and the regeneration capacity of native species in semi-arid ecosystems (Bonet, 2004). The national and international trades of these species are still increasing, suggesting their urgent integration in national afforestation program and plantation establishment projects. This is the case of *Pterocarpus erinaceous* Poir, a woody and multipurpose species. Rapid degradation was noticed on its populations due to poverty elevation. Suitable management and restoration activities are fundamental, and can help to mitigate erosion and desertification effects (Piotto and Di Noi, 2003). *P. erinaceous* is one of the most threatened and endemic multipurpose woody species in Africa. (Ouedraogo *et al.,* 2006). It is listed in Appendix II of the convention on International Trade in Endangered Species of wild Fauna and Flora (IUCN Red List, 2019). The species is used by local people for animal feeding, traditional medicine, and timber (Glèlè kakaï *et al*., 2009). The fruits, which take four months to mature, are disc-shaped, flat, and have winged margins. It is also central woody corky bulge containing several seeds. Unlike most legumes, *P. erinaceous* fruit is indehiscent and is dispersed by wind. It also floats in water and can be water dispersed (Orwa *et al.,* 2009). Poor soil, multipurpose uses, exploitation without limit and lack of scientific knowledge on the suitable propagation methods is important regarding the increasing commercialization of their derivatives, added to an ineffective forest ecosystem management constitute the major cause of the decline of its population. The species populations are mostly old and the transition from small size class to higher is low.

Please cite as: Sodimu A.I., Olaifa R.K., Baba G.O., Dahunsi O.M, Rasheed F.M. and Ademuwagun A.A. (2022). Influence of urea fertilizer on early growth of African rose wood (Pterocarpus *erinaceous Poir.*) seedlings in Kaduna State, Northern Nigeria. *Agro-Science*, **21 (1),** 117-120. DOI: https://dx.doi.org/10.4314/as.v21i1.18

Despite the high commercial value of the timber from the species and its nutritional values for cattle, no plantations have yet been established with success which is due to number of factors; deforestation, system of farming (shifting cultivation) with its attendant clear-felling of trees and so on are potential index to survival of trees species. Thus, lead to partial disruption of the closed nutrient cycle and severe degradation of natural resource base of the environment (Leakey, 1998). Hungria *et al.* (2006) observed that the reduced soil fertility that characterized tropical countries occurred due to poor soil management and constantly putting the land under cultivation year in and out loose its fertility quickly. However, the fertility of these soils depends on availability of major nutrients like N and series of conversion and reduction of soil nitrogen in form of de-nitrification; nitrification immobilization and the leaching out of soluble nitrates and nitrites from the sites greatly affect the fertility of the soil (Youdeowei *et al.,* 1985). The potential of soils of any type to supply nutrients for the growth and optimum development of trees species depends on the physical and chemical properties of the soil. Smiley *et al.* (2004) promulgated a strategy of nitrogen fertilization (liquid or solid) to improve the fertility of the sites through the application of chemical fertilizers. Tree species differed in their manure requirements and preference as such effort must be made to evaluate the appropriate fertilizer preference of any tree species for enhanced growth and development (Mukhtar *et al.,* 2021). Therefore, this research aimed to document the response to urea fertilizer of *P. erinaceous* seedling for mass propagation for plantation establishment in Northern Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Savanna Forestry Research Station nursery situated in Institute for Agricultural Research (IAR) Farm, Samaru in Bomu village, located at 11° 11′ N and 7° 38′ E and 686 m asl, Sabon-gari Local Government Area of Kaduna State. The vegetation in the Local Government Area is a 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 annual mean rainfall of 1000-1500 mm, temperature of 25.6°C, precipitation of 1,117.6 mm and relative humidity of 69% (Figure 1).

Seed Collection and Treatment

Matured seeds of *P. erinaceous* were collected from a matured tree in Savanna Forestry Research Station Quarters, Samaru-Zaria in May/June, 2020 and transported in sacks to Savanna Forestry Research Station Nursery at Bomo, Zaria. Then 240 seeds of *P. erinaceous* were washed and rinsed thoroughly, divided into four equal parts of 60 each.

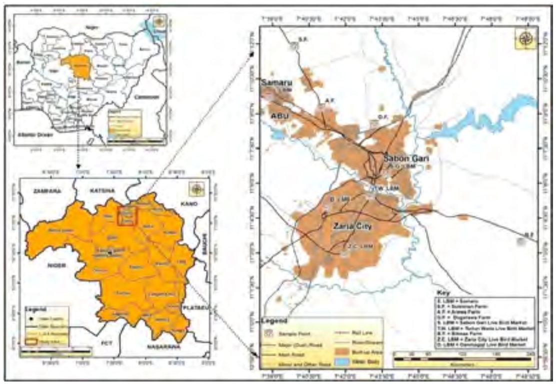

Figure 1: Showing map of the study area

These seeds were sown in four labelled germination boxes filled with sterilized river sand. At thump height with two-leaf seedling stage, 200 were selected and transplanted into nursery black polythene pots of size 20 cm × 25 cm × 25 cm, filled with 800 g of top soil collected from forest plantation. After exactly four weeks of acclimatization of the seedlings, urea fertilizer was added at five rates (0.035, 0.065, 0.095, 0.125 and 0 g control) which were applied to the transplanted seedlings. The treatments were randomly applied round the seedlings in the nursery pots using ring method of fertilizers application with 40 replicates under each of the treatment. The fertilized seedlings in the nursery pots were then allowed to adjust to the fertilizer treatments for 18 days after transplanting before measuring stem height, number of leaves and collar diameter fortnightly. The height of the seedlings was measured from the collar to the tip of apical bud using ruler calibrated in centimeter. Seedlings stem diameter as well as collar diameter were measured using Vernier caliper. Number of leaves of each experimental seedling were counted and recorded appropriately. Leaf area of seedlings was determined using the method of Clifton-Brown and Lewandowski (2000):

$$LA = 0.74 \times L \times W \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1);$$

where LA is leaf area, L is leaf length, and W is linear dimension of the width. The data obtained were subjected to analysis of variance, using statistical analysis system (SAS) and means were separated using Duncan's multiple range test at $p < 0.05$.

RESULTS AND DISCUSSION

Seedlings Height

Effect of different rates of urea fertilizer and their interaction within the species were highly significant ($p < 0.05$) on the mean height growth of seedlings of *P. erinaceous* (Table 1). The best height performance was obtained in seedlings with 0.095 g of urea (12.00 ± 0.66 cm). Seedlings supplied with urea dosages of 0.065g and 0.125 g have mean height value of 11.90 g ± 0.56 and 11.19 ± 0.61 cm respectively. The highest mean height value of 12.00 ± 0.66 cm obtained from seedlings treated with 0.095 g of urea were significantly ($p < 0.05$) different from the others and the control.

Table 1: Mean values of seedlings height of *Pterocarpus erinaceous* under different rate of urea fertilizer

Treatments of urea rate (g)	Seedlings height (cm)
0.035	11.45±.63[bc]
0.065	11.90±0.56[ab]
0.095	12.00 ±0.66[a]
0.125	11.19±0.61[c]
Control	11.61±0.51[bc]

Values with similar letters are not significantly ($p < 0.05$) different from each other.

The above result is in agreement with the work of Zekri and Obreza (2003) who observed that nitrogenous fertilizers influenced tree growth especially tree height which could favour vegetative growth. Thus, vegetative growth was at the best where seedlings received 0.095 g/pot of urea.

Number of Leaves

Different dosages of urea fertilizer and their interaction within the species had no significant ($p > 0.05$) effect on the number of leaves growth of seedlings of *P. erinaceous* (Table 2). The best highest mean number of leaves was obtained in seedlings with 0.095 g of urea (12.65 ± 0.67 cm). Seedlings supplied with urea dosages of 0.065 g recorded the mean number of leaves value of 12.25g ± 0.67 cm and 0.125 g have the lowest mean number of leaves value of 11.54 ± 0.70 cm respectively. The highest mean leaves value of 12.65 ± 0.67 cm obtained from seedlings treated with 0.095 g of urea were not significantly ($p > 0.05$) different from the lowest 12.18 ± 0.65 treated with 0.035 g of urea.

The poor performance of seedlings supplied with 0.125 g per pot of urea fertilizers may be due to high concentration of nitrogen ions beyond the uptake of the root hairs of seedlings. Ingram *et al.* (1998) observed that some tree seedlings do not generally respond to nitrogen fertilizers in excess of about 24 g m^{-2}. The present results agree with the observation of Odeleye *et al.* (2006) that urea increased number of leaves among other growth traits. Nitrogen is the only nutrient supplied by urea, whose increase in rate tended to reduce the number of leaves of *P. erinaceous* in this study. In support of this observation, Ugwu *et al.* (2020) reported that, among five soil-based nursery media, that the one with the fewest leaves of cashew (*Anacardium occidentale*) seedlings also showed the lowest content of total nitrogen as assessed 18 weeks after the cashew seeds were sown in the nursery. This nursery variant, however, produced the highest above-ground dry matter at that 18th week.

Seedlings Collar Diameter

Effects of different rates of fertilizer differed significantly ($p < 0.05$) in various effects on the stem diameter growth of seedlings of *P. erinaceous* (Table 3). The highest mean diameter of 0.33 ± 0.01 cm was observed among seedlings supplied with urea at the rate of 0.095 g. Seedlings treated with 0.035 g and 0.065 g of urea produced the mean diameter of 0.32 ± 0.01 mm. The lowest mean diameter value of 0.28 ± 0.01 mm was obtained among seedlings supplied with 0.125 g of urea per pot. However, seedlings supplied with 0.095 g of urea fertilizers were significantly different from those that had 0.035 g; 0.125 g and the control.

Table 2: Mean values of leaves in *Pterocarpus erinaceous* under different rate of urea fertilizer

Treatments of urea rate (g)	Number of leaves
0.035	12.18 ± 0.65[a]
0.065	12.25 ± 0.67[a]
0.095	12.65 ± 0.67[a]
0.125	11.54 ± 0.70[a]
Control	12.63 ± 0.67[a]

Values with similar letters are not significantly ($p < 0.05$) different from each other.

Table 3: Mean values of collar diameter in *Pterocarpus erinaceous* under different rate of urea fertilizer

Treatments of urea rate (g)	Collar diameter (mm)
0.035	0.32 ± 0.01[ab]
0.065	0.32 ± 0.01[ab]
0.095	0.33 ± 0.01[a]
0.125	0.32 ± 0.01[c]
Control	0.28 ± 0.01[bc]

Values with similar letters are not significantly ($p < 0.05$) different from each other.

The above result is in agreement with the work of Ingram *et al.* (1998) and Lawlor (2002) who observed that nitrogenous fertilizers enhanced development of biomass and collar diameter of tree crops. Tisadale *et al.* (2003) opined that urea fertilizers have proved promising in improving vegetative and collar diameter of seedlings.

Seedlings Leaf Area

The effects of different dosages of urea fertilizers significantly ($p < 0.05$) affected leaf area development and production within the seedlings of *P. erinaceous*. The best performance (190 cm^2) in the mean leaf area value was produced in seedlings treated with 0.095 g of urea. Seedlings under the 0.065 g of urea recorded the mean LA value of 164 g. The least mean LA result of 114 cm^2 was recorded among seedlings under control (Table 4) The mean LA value of seedlings that had 0.095 g of urea was significantly ($p < 0.05$) different from those of 0.035 g, 0.065 g, 0.125 g of urea and the control.

The above result is in consonance with the work of Odeleye *et al.* *(*2006) who observed that early application of inorganic fertilizers tends to increase vegetative growth of plant particularly the leaf area, since it is at this stage that plant will concentrate more assimilate to vegetative structures and improve nutrition of sites which tend to enhance stem elongation and leaf area development. This agrees with the submission of Agbede *et al.* (2018) and Aderounmu ans Olajuyigbe(2019). Tisadale *et al.* (2003) reported that urea fertilizer was promising in improving leaf area of plant. This is supported by the reports of Jin *et. al.* (2005) and Hudai *et al*. (2007).

Table 4: Mean values of seedlings leaf area in *Pterocarpus erinaceous* under different rate of urea fertilizer

Treatments of urea rate (g)	Leaf area (cm^2)
0.035	116^{a}
0.065	164^{ab}
0.095	190^{b}
0.125	124^{a}
Control	114^{a}

Values with similar letters are not significantly ($p < 0.05$) different from each other.

CONCLUSION

Based on the above findings, it can be concluded that *P. erinaceous* seedlings responded positively to certain quantity of urea fertilizer. Thus, raising of the species in the forest nursery with urea application at 0.095 g per pot of 20 cm × 25 cm × 25 cm, filled with 800 g of rich top soil is recommended.

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