



Assessment of Early Growth Response of *Moringa oleifera*, *Faidherbia albida* and *Cassia fistula* to Liquid Organic Fertilizers in the Nursery

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Abstract

A field experiment was carried out to assess the effects of two Liquid organic fertilizers (Bootstract and White fog) with the aim of investigating early growth response to *M. oleifera*, *F. albida* and *C. fistula* seedlings. The experiment was conducted at the Department of Forestry and Wildlife Nursery, Faculty of Agriculture, University of Maiduguri. It was laid out in 2×3 factorial in Completely Randomized Design (CRD), analyzed with respect to two (2) different Liquid organic fertilizer and three (3) species of trees, the growth variables measured were: seedlings height, seedlings leaf number and seedlings collar girth. The results of the study revealed that seedling height increased with weeks after germination with significant difference between Bootstract White fog from the control. The highest seedling height was the treatment with Bootstract at 6 weeks (12.33 cm). There was significant interaction between species and fertilizer in terms of plant height. The fertilizer treatments also significantly affected the collar diameter with the highest number for Bootstract (0.63) at 6 weeks with control having the lowest value of 0.26 at week 2. The leaf numbers were significantly affected at weeks 2 and 6, however, there was no significant difference ($P < 0.05$) at week 4. The study revealed that Liquid organic fertilizer demonstrated different growth performance as it supports rapid growth of *M. olifera*, *F. albida*, and *C. fistula*, seedlings more appropriately. In conclusion the result revealed that Liquid organic fertilizer has effect on the physical characteristics of the seedlings after germination emergence. It is evident from this study that Liquid organic fertilizers (White fog and Boostract) significantly enhance *M. oleifera*, *F. albida* and *C. fistula* seedlings growth.

Key words: Liquid organic fertilizer, Growth response, Collar girth, Germination emergence

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INTRODUCTION

Trees are important to humankind not only economically, environmentally, and industrially but also spiritually, historically, and aesthetically for they sustain human life

through direct and indirect gain by providing a wide range of products for survival and prosperity (Asif *et al.*, 2007). *Moringa oleifera*, *Fadherbia albida* and *Cassia fistula* are among the most important trees that deliver benefits to human life.

The agrarian lands of Sudano-Sahelian Africa are frequently associated with *F. albida*, which was originally known as *Acacia albida* as named by Delile (Wood, 1992), it belongs to the family of *Fabaceae* (APGIII, 2009). *F. albida* can grow more than 30 m in height and 1.5 m in diameter at breast height under favourable conditions. Unlike most Sahelian woody species, *F. albida* is a reverse phenology species; it loses its leaves after the first rains of the season and regrows them during the dry season (Gassama-Dia *et al.*, 2003 and Rroupsard *et al.*, 2002). The species of *F. albida* is a widely distributed in the arid and semi-arid zones of Africa (Danthu *et al.*, 2002 and Mokgolodi *et al.*, 2011). They have been shown to improve greatly soil fertility. *Moringa oleifera* is a fast growing deciduous tree that can reach a height of 10 - 2m (32-40ft) and the trunk can reach a diameter of 45cm (1.5ft). Moringa is very useful in alley cropping, animal forage, biogas, domestic cleaning agent, green manure, gum, medicine, ornamental plants, and water purification. Moringa leaves, seeds, and roots are also used in treating diseases like lung diseases, hypertension and skin infection (WHO, 2012). *Cassia fistula* is a flowering plant belonging to sub family *Caesalpinaceae* of the leguminous family (*Fabaceae*) commonly known as Golden Shower. It is a fast growing medium sized (up to 15m height and 60cm d.b.h) deciduous tree with an irregular rounded crown that is covered in yellow fluorescent flower from spring to mid-summer. It is used as ornamental tree due to its yellow colored beautiful flowers (Maqsood *et al.*, 2020).

The call for the adoption of organic form of agriculture has increased in recent decades. Organic agriculture is a form of agriculture that excludes the use of inputs that are of mineral or inorganic form, the most commonly mentioned among these inputs are the mineral or inorganic fertilizers. There is growing clamor for organic based agriculture due to the fact that mineral based inorganic fertilizers are reported to be sources of environmental pollution and even considered of health risk to humans (Zahoor *et al.*, 2014). The use of mineral fertilizers has been shown to be unsustainable having adverse effect on lands, coupled with unavailability and high prices where available. The Food and Agriculture Organization of the United Nations (FAO) have agreed that organic agriculture is a form of conventional agriculture that is environmentally sustainable growing system (Polat *et al.*, 2010). Organic fertilizers which are fertilizers of organic sources such as cow dung are known to improve long term soil fertility as well as soil physical and microbial properties, most studies therefore, focus more on solid organic fertilizers than liquid fertilizers (Yang *et al.*, 2013). Liquid organic fertilizers (LOF) are rich in organic and soluble nutrients, and therefore, are capable sustaining soil as well as improving the soil (Canali *et al.*, 2012). Compounds incorporated in bio fertilizers such as humic and fulvic acids serve as bio stimulants to plants (Ramos *et al.*, 2002). Bio fertilizers also have significant effect on microbial community diversity, enzyme activity and nutrient cycles (Martinez- Alcantara *et al.*, 2011). There are many liquid organic fertilizers in the markets under different trade names and varying compositions, there is therefore, the need to

evaluate the performance of these liquid organic fertilizers on seedlings of tree species of the sudano-sahelian region.

MATERIALS AND METHODS

Experimental Sites

The experiment was carried out at the Departmental Nursery of Forestry and Wildlife University of Maiduguri Borno state. Maiduguri lies in the semi-arid zone of Nigeria within latitude 11⁰15 North and longitude 30⁰05 east. It is characterized by a short time raining season (3-4 months of 500mm-600mm annually) and a long period of dry season and maximum temperatures can reach up to 48⁰c in April and minimum temperature can be as low as 15⁰C between December and January (BOSG, 2015).

Seed source

Faiherbia albida, *Cassia fistula* and *Moringa oleifera* seeds were collected from different mother trees within the campus of University of Maiduguri, Borno State in January 2021. The seeds were extracted from the pods by splitting the pods carefully using mechanical means. Seed dormancy was broken by soaking the seeds into cold water for 24 hours to rupture the hard coat and to enhance the germination of seeds.

Potting media

The potting media used for raising the seedlings in this experiment were top soil and river sand; total number of 120 seed was sown in a medium size poly pots.

Treatments

The treatments used for this study Boosttract and White fog are Bio stimulant plant strengtheners. They maximize crop yields through the use of liquid organic fertilizer, they contain both macro and micronutrients and are highly soluble organic compounds that will not block sprayers.

Table 1: Nutritional Composition of Boosttract

Nutrients	Quantity
Seaward extract	150g/L
Nitrogen (N)	150g/L
Phosphorous pentoxide (P ₂ O ₅)	40g/L
Potassium monoxide (K ₂ O)	50g/L
Amino Acids	10g/L
Organic matter	40g/L

Table 2: Nutritional Composition of White fog

Nutrients	Quantity
Humidity (moisture content)	81.9%
pH level	7.25%
Mass fraction of humate	85.0 g/L
Mass fraction of Fulvate	29.0 g/L
Phosphorus	0.31%
Calcium	0.13%
Zinc	12.8mg/kg
Cobalt	0.75mg/kg
Cytokinin	0.4%

Seed sowing

The treated seeds were sown directly into poly pots filled with sterilized river sand. Two seeds were sown per poly pot, approximately 2cm deep into the pots. The seeds were lightly covered with sand and watering was done until germination of the seeds. The seedlings were allowed for two weeks' growth before fertilizer application.

Experimental design

The experiment was 2×3 factorial in a Completely Randomized Design with two treatments of Liquid organic fertilizer (White fog & Boostract) and 3 species replicated five times and a control.

Model of the design is: $Y_{ijk} = \mu + A_i + B_j + (AB)_{ij} + E_{ijk}$

Where:

Y_{ij} = Individual observation

μ = General mean

A_i = Effect of factor A

B_j = Effect of factor B

AB = Effect of interaction AB

E_{ijk} = Experimental error in ij

Data collection procedure

Data were collected for the following early growth parameters: seedling height, collar diameter and number of leaves produced. The height of seedling in each poly pot was measured using a graduated meter rule. Vernier caliper was used to measure the collar diameter of seedling. The production of new leaves was recorded by visually counting the number of leaves produced. These parameters were measured fortnightly. Data collected were subjected to Analysis of Variance (ANOVA). Statistical package for social science (SPSS) was used to analyze the data.

RESULTS AND DISCUSSION

Physical characteristics are the visually determinable attributes of tree seedlings in the nursery. The major morphological criteria often used to describe plant seedling potentials are shoot height, leaf number and seedling collar diameter. These are some of the bases to qualify good seedlings for nursery establishment (Egbewole *et al.*, 2018).

The effects of the two LOF (Table 3) on seedling height (cm) revealed a progressive increase in height with increase in weeks (2, 4 and 6 weeks). At week two, there was no significant difference between White fog (7.33) and control (6.73) at $P < 0.05$. There was however, a significant difference between Bootstract (7.83) and control ($P < 0.05$). At week 4, there was significant difference between the two LOF (Bootstract 9.80 and White fog 9.67) with the control (6.87). The same pattern was recorded at 6 weeks where the values were 12.33, 12.33 and 9.20 for Bootstract, White fog and the control respectively. In terms of the effects of the species, at 2 weeks there was significant difference in height growth among the three species with each species significantly differing from each other (*M. oleifera* 12.13, *F. albida* 4.10 and *C. fistula* 5.67 respectively). At 4 weeks, *M. oleifera* (12.87) significantly differed from *F. albida* (7.40) and *C. fistula* (7.67), with the latter two not significantly differing from each other. At 6 weeks *M. oleifera* (17.60) gave the highest height growth, followed by *F. albida* (12.20) and *C. fistula* (9.67), the three species each significantly differing from each other. The interaction between effects of the two factors A (fertilizer) and B (species) indicated significant interaction meaning the factors are independent of each other. The significantly higher values for seedling height reported in Boostract application can be explained in the nutritional content of the LOF (Table 1), Boostract is rich in the essential nutrients (N, P, K) and other nutrients. Similar results have been reported in seedlings of other tree species by different authors (Egbewole, 2018; Bungard *et al.*, 2000 and Hall *et al.*, 2003). They reported higher vegetative growth in seedlings treated with organic fertilizers rich in essential nutrients especially N.

Table 3: Effects of Two Liquid Organic Fertilizers on the Seedling Height of Three Different Species

Seedling Height			
Fertilizers (A)	2 weeks	4 weeks	6 weeks
Boostract	7.83 ^a	9.80 ^a	2.33 ^a
White fog	7.33 ^{ab}	9.67 ^a	12.33 ^a
Control	6.73 ^b	6.87 ^b	9.20 ^b
LSD (0.05)	N.S	*	*
Species (B)			
<i>M. oleifera</i>	12.13 ^a	12.87 ^a	17.60 ^a
<i>F. albida</i>	4.10 ^c	7.40 ^b	12.20 ^b
<i>C. fistula</i>	5.67 ^b	7.67 ^b	9.67 ^c
LSD (0.05)	1.06	1.24	1.19
Interaction	4	5	4
A×B	*	*	*

*Means carrying the same superscripts along columns are not significantly different

Source: Field Survey, 2021

The effects of the different treatments on collar diameter is presented in Table 4. There was an increment in collar height with increase in weeks, values of collar diameter for Bootstract were 0.30, 0.39 and 0.63 for 2, 4, and 6 weeks respectively, for White fog the values were 0.32, 0.37 and 0.61 respectively. Collar diameter for control were 0.26, 0.26 and 0.29. The effect of species on collar diameter shows significant differences among the three species with increase in the diameter as weeks' increase. At 2 weeks, there was significant differences among all the species (0.38, 0.23 and 0.18 for *M. oleifera*, *F. albida* and *C. fistula* respectively). At week 4, there was significant difference between *M. oleifera* (0.47) and both *F. albida* and *C. fistula* (0.31 and 0.27 respectively) with no significant differences between the latter two species. At 6 weeks there was a significant difference between all the species with *M. oleifera* having the highest and most significant value (0.95). The interaction effect between fertilizers and species indicated that at weeks 2 and 4 were not significant indicating that the two factors are dependent, while at 6 weeks the 4 interactions were significant indicating they are independent.

Table 4: Effects of Two Liquid Organic Fertilizers on the Collar Diameter of Three Different Species

Fertilizers (A)	Collar Diameter (cm)		
	2 weeks	4 weeks	6 weeks
Boostract	0.30 ^a	0.39 ^a	0.63 ^a
White fog	0.32 ^a	0.37 ^a	0.61 ^a
Control	0.26 ^b	0.29 ^b	0.49 ^b
LSD (0.05)	*	*	*
Species (B)			
<i>M. oleifera</i>	0.38 ^a	0.47 ^a	0.95 ^a
<i>F. albida</i>	0.23 ^b	0.31 ^b	0.51 ^b
<i>C. fistula</i>	0.18 ^c	0.27 ^b	0.37 ^c
LSD (0.05)	0.05	0.07	0.08
Interaction	5	4	4
A×B	N.S	N.S	*

*Means carrying the same superscripts along columns are not significantly different

Source: Field Survey, 2021

The number of leaves observed in response to fertilizer application indicated significant differences at weeks 2 and 6 while it was not significant at week 4 (Table 5). At two weeks, White fog gave the highest number (5.07) while Bootstract and control were 4.07 and 4.20 respectively with no significant difference between the latter two. At 4 weeks, there was no significant difference between all the treatments with Bootstract having the highest value of 9.80 and the control having the least value of 8.47. At 6 weeks, White fog had the highest value of 9.07 which is significantly different from both Bootstract (7.47) and control (6.60) respectively. The species effect indicated that at 2 weeks *M. oleifera* (5.87) had the highest value which is significantly different from *F. albida* (4.13) and *C. fistula* (3.33) the latter two being not significantly different. At week 4, there was significant difference between the treatments with *F. albida* (8.87) having the highest number and significantly different from the other two species, while *C. fistula* (5.73) and *M. oleifera* (4.73) were not significantly different from each other. At week 6, there was significant difference between all the species with *F. albida* (12.87) having the highest value while *C. fistula* and *M. oleifera* having 6.07 and 4.20 respectively. Interaction between the factors revealed no significant differences in weeks 2 and 4 indicating that the factors are dependent while at 6 weeks the interaction was significant indicating independence of the factors.

Results from this study revealed a general trend of increase in seedling height, collar diameter and leaf number with increase in weeks. The increase is however, greater in the LOF treated seedlings. The better performance with time is most likely to be attributed to the release of nutrients at a slower rate in organic fertilizers. The significantly higher values for seedling height reported in Bootstract application can be explained in the nutritional content of the LOF (Table 1), Bootstract is rich in the essential nutrients (N, P, K) and other nutrients. White fog is also very rich in mineral nutrients such as P and Ca, however, the presence of N in Bootstract is most likely to impact growth characteristics due to the effect of N in vegetative growth in

plants. Similar results have been reported in seedlings of other tree species by different authors (Egbewole, 2018; Bungard *et al.*, 2000; Hall *et al.*, 2003; Rotowa *et al.*, 2017; Dania *et al.*, 2014). These authors reported higher seedling growth with organic fertilizers rich in essential nutrients especially N, P and K.

Table 5: Effects of Two Liquid Organic Fertilizers on the Number of Leaves of Three Different Species

Fertilizers (A)	Number of Leaves		
	2 weeks	4 weeks	6 weeks
Boostract	4.07 ^b	9.80 ^a	7.47 ^b
White fog	5.07 ^a	9.67 ^a	9.07 ^a
Control	4.20 ^b	8.47 ^a	6.60 ^b
LSD (0.05)	*	N.S	*
Species (B)			
<i>M. oleifera</i>	5.87 ^a	4.73 ^b	4.20 ^c
<i>F. albida</i>	4.13 ^b	8.87 ^a	12.87 ^a
<i>C. fistula</i>	3.33 ^b	5.73 ^b	6.07 ^b
LSD (0.05)	0.80	0.98	1.04
Interaction	5	3	6
A×B	N.S	N.S	*

Source: Field Survey, 2021

Liquid organic fertilizer (LOF) application affected the parameters of the seedling that were assessed. Studies on other organic fertilizers such as cow dung and poultry droppings have also reported similar findings. Fredrick *et al.* (2017) reported significant differences in seedling height, and leaf number at all stages of growth and in seedling collar diameter in their study on effect of growth media on the germination and early growth seedlings performance of *Chrysophyllum albidum*. Similarly, Egbewole *et al.* (2016) in their study on seed germination and early growth trial of *Ceiba Pentandras* revealed that *Ceiba Pentandra* seedlings height, collar girth, collar diameter, leaf area and leaf number were significantly affected by organic matter application.

Conclusion

The results revealed that Liquid organic fertilizer has effect on the physical characteristics of the seedlings after germination emergence. It is evident from this investigation that Liquid organic fertilizers (Boostract and White fog) significantly enhance *M. olifera*, *F. albida* and *C. festula* seedlings growth.

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