

1 **Evaluation of Different Nutritional and Soil Sources on the Early Growth of**
2 ***Moringa oleifera* (Lam)**

3
4 **ABSTRACT**

5 In any plantation establishment programme their must be adequate number of healthy
6 seedlings and these depend on the nutrition and care given to them at the nursery stage.
7 Pot experiment was conducted to assess the response of *Moringa oleifera* (Lam)
8 seedlings to different soil and nutritional sources at nursery stage. One hundred seeds
9 were obtained from Centre for Environmental Renewable Resources Research and
10 Development (CENRAD) Ibadan, Nigeria and sown in germination trays. Seed
11 germination was completed between 10-15 days, 36 uniformly growing seedlings were
12 transplanted into polythene pots of size 29×25cm and were filled with different soil
13 sources at 500gm (arable) soil, forest reserve soil and natural forest mixed with
14 nutritional sources of the same ratio (10gm) i.e. poultry manure, cow dung and N.P.K
15 15.15.15. The experiment was factorial arranged in a completely randomized design.
16 Result showed that pots with natural forest soil mixed with 10gm N.P.K (s_3f_3) produced
17 seedlings with highest value In plant height (76.30cm), stem diameter (3.47mm) and
18 number of branches (10.00) which was significantly different ($p < 0.01$) from the other
19 treatments. The least value in plant height (30.70cm) stem diameter (1.50mm) and
20 number of branches (3.3) were recorded in pots with forest reserve soil mixed with cow
21 dung (s_2f_2). Interaction effect of soil and nutritional sources were significant for all the
22 growth parameters assessed ($p < 0.01$). Natural forest soils treated with N.P.K 15.15.15
23 should be employed in raising *Moringa oleifera* seedlings at nursery stage for optimum
24 performance.

25 **Key Words:** *Moringa oleifera*, Growth, Nutritional sources, Soil

26 **INTRODUCTION**

27 The forest plays an important role in protecting the soil, ameliorating the environment
28 and protecting water resources. Non-timber forest products are very essential in urban
29 and rural life, under which *Moringa oleifera* (Lam) belong (Leone *et al.*, 2015). *Moringa*
30 *oleifera* is the most widely cultivated species of the genus *Moringa*, is the only genus in
31 the family Moringaceae. English common names include: Moringa, (Olson, 2010)
32 drumstick tree (from the appearance of the long, slender, triangular seed pods),
33 horseradish tree (from the taste of the roots, which resembles horseradish, ben oil tree, or
34 benzoil tree (from the oil which is derived from the seeds). It is a fast-growing, drought-
35 resistance tree, native to the southern foothills of the Himalayas in the northwestern
36 Indian, and widely cultivated in tropical and subtropical areas where its young seed pods
37 and leaves are used as vegetables. It can also be used for water purification and washing,
38 and is sometimes used in herbal medicine (Torondel, *et al.*, 2014).

39 It has become a clear issue that man cannot sufficiently sustain its existence without
40 adequately improving the level of food and fiber production as raw material for industrial
41 uses. Most tropical soils are deficient in nitrogen and other macronutrients and uptake of
42 these limited quantities of nutrients by plant roots from litters is difficult (Jose, 2003).
43 Nitrogen allows plants to produce proteins needed to build living tissues for green stems,
44 leaves and strong roots, phosphorus helps move energy throughout the plant while
45 potassium aids plants in adapting sugars needed in growth. Fertilization is the only way
46 to supply nutrients within a short period of time. Adegbidi et al, (2003) reported that the
47 effects of the mixed use of chemical fertilizer and organic matter on the growth of trees
48 and soil fertility vary substantially according to the fertilizer amounts and the organic
49 manure characteristics. The need to investigate the response of *Moringa oleifera* to
50 different ratios of inorganic and organic fertilizer application on soil sources is essential
51 as this will determine its optimum growth performance at the nursery stage. The objective
52 of the study was to investigate the effect of different **nutritional and** soil sources on early
53 growth of *M. oleifera* **so** as to find the optimum dose of **fertilizer** for raising quality
54 seedlings.

55 MATERIALS AND METHODS

56 The experiment was carried out at the West African Hardwood Improvement Project
57 (WAHIP) of the Forestry Research Institute of Nigeria (FRIN), Ibadan (Latitude 7°39'13"
58 and longitude 3°8'28"E. The Institute is situated at Jericho Hills in Ibadan North West
59 Local Government Area of Oyo State. The climate of the area is tropically dominated by
60 rainfall pattern ranging between 1400 - 1500mm, average temperature is 30°C. It has 2
61 distinct seasons rainy season (April – October) and dry season (November – March)
62 (FRIN, 2015). The black polythene pots were purchased from CENRAD, Ibadan. Cow
63 dung and poultry manure were collected from Federal College of Forestry Teaching and
64 Research Farm Ibadan. N. P. K 15.15.15 fertilizer was obtained from Centre for
65 Environmental Renewable Resources and Management Development (CENRAD),
66 Jericho, Ibadan. The natural forest soil was collected from FRIN arboretum, forest
67 reserve soil was collected from *Pinus caribea* Morelet plantation FRIN while the
68 cultivated soil used was collected from Federal College of Forestry Ibadan farm. One
69 hundred *Moringa oleifera* seeds were obtained from CENRAD and sown in germination
70 trays filled with sterilized river sand.

71 Cow dung and poultry manure were dried, crushed and sieved with 2mm sieve while the
72 soil samples were also sieved. The same ratio of cow dung, poultry manure and fertilizer
73 (N.P.K. 15.15.15) were measured in grams (10gm) and mixed with the soil samples, each
74 treatment contained the same level of organic and inorganic fertilizers. 10gm of organic
75 fertilizer, (cow dung and poultry manure of same ratio) and 10gm of N.P.K. 15.15.15
76 were weighed in the soil laboratory of Forestry Research Institute of Nigeria. 10mg of
77 cow dung and poultry manure were applied on 36 seedlings i.e. 18 seedlings contained
78 10gm of cow dung and 18 seedlings contained 10gm of poultry manure, while 18
79 seedlings contained 10gm of N.P.K. 15.15.15. Eighteen seedlings were used as control. A
80 total of 72 seedlings were transplanted after four weeks into polythene pots of 29×25cm
81 size filled with the different potting mixtures. Watering of the seedlings was done once

82 daily. Seedling height (cm), stem diameter (mm) and number of branches were assessed
 83 after 4weeks for 12 weeks.

84 **Table 1:** Laboratory Analysis of Organic and Inorganic Fertilizer

85 Sample Code	%N	%P	%K
86 Poultry manure	3.47	1.18	1.38
87 Cow dung	4.06	0.33	0.77
88 N.P.K. 15.15.15	15.00	15.00	15.00

89 Treatment Combination

- 90 Where; (1) (i) S₁f₀ - Arable soil without fertilizer (control)
 91 (ii) S₁f₁ - Arable soil with poultry manure
 92 (iii) S₁f₂ - Arable soil with cowdung
 93 (iv) S₁f₃ - Arable soil with N.P.K (15.15.15)
 94 (2) (i) S₂f₀ - Forest reserve soil without fertilizer (control)
 95 (ii) S₂f₁ - Forest reserve soil with poultry manure
 96 (iii) S₂f₂ - Forest reserve soil with cowdung
 97 (iv) S₂f₃ - Forest reserve soil with N.P.K. (15.15.15)
 98 (3) (i) S₃f₀ - Natural Forest soil without fertilizer (control)
 99 (ii) S₃f₁ - Natural Forest soil with poultry manure
 100 (iii) S₃f₂ - Natural Forest soil with cowdung
 101 (iv) S₃f₃ - Natural forest soil with N.P.K (15.15.15)

102 Data Analysis

103 Analysis of variance was used to analyze the data obtained while least significant
 104 difference (LSD) was used to separate the means where significant.

105 RESULTS AND DISCUSSION

106 **Table2:** Effect of treatment on stem diameter (mm) of *Moringa oleifera* seedlings

Treatment	2WAT	4WAT	6WAT	8WAT	10WAT	12WAT
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S ₁ F ₀	1.90	2.06	2.00	2.03	2.17	3.19
S ₁ F ₁	1.93	2.07	1.97	1.97	2.17	3.20
S ₁ F ₂	2.03	2.10	2.00	2.03	2.20	2.84
S ₁ F ₃	2.07	2.20	2.40	2.63	3.17	4.28
S ₂ F ₀	1.97	2.03	0.63	0.63	0.63	1.45
S ₂ F ₁	2.10	2.13	1.97	1.93	2.00	3.17
S ₂ F ₂	2.07	1.40	1.40	1.43	1.50	2.42
S ₂ F ₃	2.03	2.03	0.00	0.00	0.00	0.00
S ₃ F ₀	1.90	2.03	1.40	3.80	1.77	2.85
S ₃ F ₁	2.03	2.07	2.13	2.17	2.60	3.00
S ₃ F ₂	1.90	2.03	2.17	2.22	2.60	3.00
S ₃ F ₃	1.93	2.00	2.07	2.47	3.47	4.53
Mean	1.99	2.01	1.68	1.94	2.02	2.83
Significance	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***
Se±	0.1023	0.1023	0.1023	0.1023	0.1023	0.1023
LSD	0.9105	0.9105	0.9105	0.9105	0.9105	0.9105
C.V%	5.3	5.3	5.3	5.3	5.3	5.3

107 **Table 2:** Effect of treatment on stem diameter (mm) of *Moringa oleifera* seedlings
108 Where: - WAT= Week after transplanting*** significantly difference (p<0.001).

109 Table 2 shows that there was no significant difference in stem diameter of the seedlings
110 subjected to various treatments at P<0.001 while N.P.K. 15.15.15 in natural forest soil
111 (S₃F₃) had the highest stem diameter of 4.53mm. There was a continuous increase in stem
112 diameter across the weeks. This was followed by N.P.K. 15.15.15 in arable soil that had
113 value of 4.28mm against **cow dung** in forest reserve soil which had the lowest stem
114 diameter of 1.5mm across the weeks. This confirms the findings of Waheed et al. (2001)
115 for *Camelia sinensis* that nitrogen containing fertilizers such as N. P.K had a significant
116 effect on seedling growth parameters. Almeida (1997) had earlier reported that N.P.K
117 fertilizer gave a positive response in seedling growth of cashew. This also supports the
118 findings of Larcheveque et al. (2011) that chemical fertilizers promote higher growth and
119 root development compared to livestock organic manure in a Poplar plantation.

Table 3: Effect of soil mixture on the height (cm) of *Moringa oleifera* seedlings

Treatment	2WAT	4WAT	6WAT	8WAT	10WAT	12WAT
S ₁ F ₀	32.40	34.50	36.40	37.40	40.00	43.04
S ₁ F ₁	28.40	37.33	41.33	42.33	46.00	54.25
S ₁ F ₂	32.00	36.67	39.50	34.17	46.67	55.80
S ₁ F ₃	40.17	41.33	46.00	54.33	66.67	74.55
S ₂ F ₀	32.33	31.67	11.00	11.67	12.33	15.61
S ₂ F ₁	34.73	33.73	35.17	37.83	42.50	48.72
S ₂ F ₂	24.83	20.67	28.77	30.00	30.67	35.74
S ₂ F ₃	26.33	34.33	0.00	0.00	0.00	0.00
S ₃ F ₀	28.50	31.50	32.17	35.00	36.00	39.50
S ₃ F ₁	34.83	35.57	46.50	50.33	52.33	60.28
S ₃ F ₂	34.50	34.17	42.33	49.33	54.67	64.45
S ₃ F ₃	30.90	32.33	43.33	58.00	73.33	89.67
Mean	31.66	33.81	3.38	37.45	41.74	48.47
significance	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***
Se±	3.638	3.638	3.638	3.638	3.638	3.638
LSD	0.9105	0.9105	0.9105	0.9105	0.9105	0.9105
C.V%	5.3	5.3	5.3	5.3	5.3	5.3

121 Where:- WAT = Week after transplanting*** significantly difference (<0.001).

122 Table 3 revealed that there was no significant difference in the height of Moringa
 123 seedlings among the treatments at P<0.001. N.P.K. 15.15.15 in natural forest soil had a
 124 height of 89.67cm (P<0.001), this was achieved due to the increase in the growth rate
 125 (height) of Moringa across the weeks. This was followed by N.P.K. 15.15.15 in arable
 126 soil that had a value of 74.55cm, the trend was also maintained across the weeks while
 127 cowdung in forest reserve soil had the lowest height of 35.74cm. Similar positive results
 128 has been reported by (Hoque, *et al.*, 2004) seedling growth was enhanced significantly
 129 with the application of N.P.K fertilizer. Tree seedlings need nutrients to grow, nitrogen
 130 for lots of green leaves, phosphorus for new tissues particularly the roots and potassium
 131 for seedling vigour.

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Table 4: Effect of soil mixture on number of branches of *Moringa oleifera* seedlings

Treatment	2WAT	4WAT	6WAT	8WAT	10WAT	12WAT
S ₁ F ₀	6.00	6.00	5.67	6.33	6.67	6.67
S ₁ F ₁	7.00	6.00	6.33	6.00	6.00	6.00
S ₁ F ₂	5.67	4.67	6.00	7.33	6.67	7.52
S ₁ F ₃	4.00	6.00	8.67	9.67	9.67	10.23
S ₂ F ₀	5.00	2.00	1.33	1.33	1.33	1.33
S ₂ F ₁	6.33	3.67	4.00	5.00	5.33	6.50
S ₂ F ₂	5.67	3.00	3.00	3.67	3.33	3.33
S ₂ F ₃	5.67	4.33	0.00	0.00	0.00	4.33
S ₃ F ₀	5.00	3.67	4.67	4.67	4.00	4.00
S ₃ F ₁	6.67	6.33	7.33	6.67	6.67	6.67
S ₃ F ₂	6.33	7.00	7.00	8.67	8.00	8.00
S ₃ F ₃	6.33	6.33	8.67	10.33	10.00	11.00
Mean	5.81	4.91	5.58	6.17	6.00	6.33
significance	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***
Se±	0.570	0.570	0.570	0.570	0.570	0.570
LSD	2.830	2.830	2.830	2.830	2.830	2.830
C.V%	10.3	10.3	10.3	10.3	10.3	10.3

133 Where: WAT= week after transplanting*** significantly different (P < 0.001)

134 Table 4 shows that there were significant differences in number of branches of Moringa
135 seedlings among the treatments at P<0.001. N.P.K. 15.15.15 in natural forest soil (S₃F₃)
136 had the highest value of 10.0. This was achieved due to continuous production in number
137 of branches across the weeks. This was followed by N.P.K. 15.15.15 in arable soil that
138 had the value of 9.7 which was also maintained across the weeks while **cow dung** in
139 forest reserve soil (S₂F₂) had the lowest value of 3.33 across the weeks. This supports the
140 findings of Jaenicke (1999) who stated that **cow dung** contains 0.3% Nitrogen, 0.2%
141 phosphoric acid and 0.1- 0.5% while Ajay, (2017) also reported that **cow dung** is not as
142 rich in nitrogen as many other types of fertilizers. He reported that it has about 8%
143 nitrogen, 2% phosphorus and 1% potassium. These nutrients are also slowly infused into
144 the soil.

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148 **Conclusion**

149 Based on the findings of these studies, seedlings raised with N.P.K. 15.15.15 mixed with
150 natural forest soil had the highest stem diameter, height and number of branches. Also,
151 there were significant differences in seedlings height, stem diameter and branches at
152 $P < 0.001$, interaction effect among soil and nutritional sources was also significant.

153 **Recommendation**

154 Natural forest soil mixed with N.P.K. 15:15:15 should be used in raising seedlings of
155 *Moringa oleifera* for optimum growth performance since the seedlings presented most
156 noticeable positive influence on seedling growth in the nursery.

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