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Combined Effects of Different Doses of DAP Mineral Fertilizer (18% N AND 46%P) and Watering Frequency on the Initial Growth of *Moringa oleifera* Lam. in the Commune of Diffa

Rabo Younoussou[1]* and Mahamane Ali[2]

[1]*University of Diffa, Faculty of Agronomic and ecologic Sciences, Niger*
[2]*University of Diffa, Faculty of Agronomic Sciences, Niger Abdou Moumouni University of Niamey, Faculty of Science and Technology, Garba Mounkaila Laboratory, Niger*

**Corresponding author*

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ABSTRACT

Combined effects of different doses of DAP mineral fertilizer (18% N and 46%P) and watering frequency on the initial growth of Moringa oleifera Lam. in the commune of Diffa. *Moringa oleifera* is a leafy vegetable which cultivation and consumption are of increasing interest to the Nigerien population. This study, conducted in the region of Diffa, aims at studying the combined effects of different doses of mineral fertilizer DAP (18% N and 46%P) and watering frequency on the initial growth of *M. oleifera*. To do this, a total experimental randomization was set up. Two factors were studied, the fertilizer dose factor (A) and the watering frequency factor (B) with four (4) and three (3) levels respectively. In contrast, treatment A4B1, where *M. oleifera* plants received no dose of DAP mineral fertilizer and were watered twice (2) a day, had the lowest yield of leaf biomass. The ACP revealed that the A1B1 and A1B2 and, to a lesser extent, A1B3 treatments are characterized by long and wide leaves, a good yield of fresh biomass and dry matter and secondarily by a long main stem, while the A2B2 and A2B1 treatments are characterized by a very good diameter of the main stem, poor yield of fresh biomass and dry matter and shorter roots with a small diameter. The HCA suggested seven (7) groups. At the end of this study, it is advisable to propose to the producers to use three (3) pinches of DAP fertilizer and to water the plants two (2) times a day for a better production of leaf biomass of the species.

Introduction

Moringa oleifera, commonly known as moringa, is grown in Niger for its leaves, which are largely used in diets. According to Broin (2005), the leaves, fruits, young stems, roots and flowers are edible and eaten all over the world. The leaves can be eaten fresh or in powdered form. The leaves of *M. oleifera* are associated with spices such as chili pepper. They can also be prepared in soups or salads according to Foidl *et al.,* (2001). Young green pods can be eaten boiled like beans. Dry seeds can be powdered and used to season sauces, while powdered roots from seedlings can be used to enhance seasoning (Foidl *et al.,* 2001). According to Mawouma *et al.,* (2014), the reasons for eating *M. oleifera* leaves are essentially based on three factors: the dietary tradition of the household, the organoleptic qualities (taste) of the leaves, and the nutritional virtues of the leaves.

In addition, nutritional analyses have shown that *M. oleifera* leaves are richer in vitamins, minerals and proteins than most vegetables. They contain twice as much protein and calcium as milk, as much potassium as bananas, as much vitamin A as carrots, as much iron as beef or lentils, and twice as much vitamin C as an orange (Bonkoungou, 2001). Also, the production of *M. oleifera* leaves can be a profitable economic activity to meet the growing demand for leaves (Rabo, 2019; Gamatié, 2006; Alhado, 2014). All these reasons justify the interest that Nigeriens give to the production of *M. oleifera*.

Moringa production is done in both the rainy and dry seasons. During this last season, the cultivation of *M. oleifera* is irrigated by it. However, it is during this season that the water tables dry up and irrigation becomes more and more difficult, especially around the months of April and May. Some producers are even forced to abandon their farms for lack of water.

Through this study, it is necessary to determine an optimal watering frequency that would not only maximize the production of *M. oleifera* leaves but also rationally manage groundwater. At the same time, to boost leaf production, farmers provide mineral fertilizers and organic manure (Rabo, 2019). However, this contribution is made by the producers, some of whom have not received any training.

According to Rabo (2019), the use of mineral fertilizers is a phenomenon that is becoming more and more widespread in crop production systems, most often in defiance of the recommendations of the competent services. The quantities of fertilisers used never reach the prescribed doses, but also neither the application deadlines nor the nature of the fertilisers are respected, even though these crops are associated with *M. oleifera*. This author justifies this discrepancy between the doses of fertiliser used by the operators of the two sites and those prescribed by the lack of financial means but also of technical supervision. This study aims to determine the minimum dose of DAP that would allow maximum leaf production of *M. oleifera*.

In response to the frequency of watering, what would be the dose of DAP fertilizer that would allow *M. oleifera* to have optimal initial growth? To answer this question, this study aims to determine the "Combined effects of different doses of DAP mineral fertilizer (18% N and 46%P) and watering frequency on the initial growth of *M. oleifera*".

Materials and Methods

Plant and physical material used

The plant material used is mainly composed of seeds of the local variety of *M. oleifera* and the mineral fertilizer DAP (Diammonium phosphate or Diammonium phosphate) or 18-46-0 (18% N, 46% P_2O_5, 0% K_2O)

Experimental design

As part of this study, two (2) factors were studied: the dose factor of DAP mineral fertilizer (A) and the frequency factor of watering (B).

Thus, Factor A consists of four (4) levels:

- ✓ Level 1 (A1): *M. oleifera* plants received three (3) pinches of DAP mineral fertilizer;
- ✓ Level 2 (A2): *M. oleifera* plants received two (2) pinches of DAP mineral fertilizer;
- ✓ Level 3 (A3): *M. oleifera* plants received one (1) pinch of DAP mineral fertilizer;
- ✓ Level 4 (A4): *M. oleifera* plants received (0) dose of DAP mineral fertilizer;

Factor B, on the other hand, consists of three (3) levels:

- ✓ Level 1 (B1): *M. oleifera* plants were watered twice (2) a day, in the morning and in the evening;
- ✓ Level 2 (B2): *M. oleifera* plants were watered once (1) a day, in the morning;
- ✓ Level 3 (B3): *M. oleifera* plants were watered one (1) time in the morning, every two (2) days;

Each level of the first factor was combined with each of the levels of the second factor thus giving 3*4 = 12 treatments. The experimental device is a device used is a total randomization device with three (3) replicates. Plastic pots were used, i.e. 3*12=36 plastic pots.

Data collection and processing

In sum, the study involved 36 plastic pots containing one

M. oleifera plant each. Every three days, the height and the counting of the number of leaves of each plant as well as the length and the width of *M. oleifera* leaves were measured. The diameter of the plants was also measured every week. At the end, the leaf biomass was harvested and the quantity of each pot was determined. The harvested biomass was dried and the dry matter content was determined. At the end of the experiment, not only the number of roots but also the diameter and length of the main root were determined.

The data collected were submitted to the Excel spreadsheet and the Minitab 18 software for statistical processing. The Shapiro-Wilks test and the Levene test were used to check the normality of the data and the homogeneity of the variances, respectively, before subjecting them to the analysis of variance (ANOVA). Multivariate analyses were provided.

Results and Discussion

Germination rate

Germination began on 14/10/2023, four (4) days after sowing, and all grains germinated one week after this date. The germination rate was 100%.

Effect of treatments on the length of the main stem

Table 1 gives the average length of the main stem according to the treatments. The analysis of this table shows that there is a statistically significant difference between the different treatments at the 5% threshold ($p = 0.0141$). The A3B2 and A1B1 treatments had, in fact, the longest main stem on average with the values of 47±3 and 45±3 cm respectively. In contrast, the A2B2 and A3B3 treatments with the mean amounts of 33.33±2.89 and 30±5 cm respectively had the shortest main stem.

Effect of treatments on the diameter of the main stem

The average diameter of the main stem, depending on the treatments, is given in Table 1. The analysis of this table shows that there is no statistically significant difference between the different treatments at the 5% threshold ($p = 0.37$). Thus, the treatments did not have a significant effect on the diameter of the main stem, which averaged 1.1956±0.157 cm.

Effect of treatments on leaf number

Table 1 shows the average number of leaves per plant depending on the treatments. The analysis of this table notes that there is a statistically significant difference between the different treatments at the 5% threshold ($p = 0.001$). Thus, the A1B1 treatment is the one with the most leaves per plant on average with an average of 16,667±1,528 leaves/plant. However, with an average of 10,667±1,528 leaves/plant, the A2B1 treatment is the one that produces fewer leaves/plant on average.

Effect of treatments on leaf length

The leaf length of *M. oleifera* is given in Table 1. The analysis of this table shows that there is a statistically significant difference between the different treatments at the 5% threshold ($p < 0.0001$). Thus, the longest leaves on average were obtained with the A1B1 treatment with an average length of 25±1 cm. However, the A3B3 treatment with an average leaf length of 13±3.61 cm was the one that had the shortest leaves on average.

Effect of treatments on leaf width

Table 1 shows the average leaf width by treatment. Analysis of this table notes that there is a statistically significant difference between the different treatments at the 5% threshold ($p = 0.004$). Thus, the A1B1 treatment was the one that had the widest leaves on average with an average width of 3.1337±0.0738 cm. However, treatments A4B1, A4B2, A3B3 and A4B3 with mean widths of 2.4755±0.1684, 2.2992±0.1004, 2.4241±0.1053 and 2.53±0.488 cm respectively had the least wide leaves on average.

Effect of treatments on leaf biomass of *M. oleifera*

The effect of treatments on leaf biomass per plant is shown in Table 1. The table analysis shows that there was a statistically significant difference between the different treatments at the 5% threshold ($p = 0.005$). In fact, the A1B1, A1B2 and A1B3 treatments with 25.808±1.661, 25.78±0.506 and 27.426±1.648 g/plant respectively had the best yields of leaf biomass in contrast to A4B1 which, with an average yield of 15.96±2.03 g/plant, obtained the lowest yield of leaf biomass.

Effect of Dry Matter Treatments

Table 1 shows the amount of dry matter per plant of *M.*

oleifera as a function of treatments. Analysis of this table shows that there is a statistically significant difference between the different treatments at the 5% threshold (p = 0.008). The A1B2 treatment with an average dry matter amount of 5.333±1.528 g/plant had the best result, unlike A4B1 and A4B2 which have the lowest average dry matter amounts with 2.667±0.577 and 2.667±0.577 g/plant, respectively.

Effect of treatments on the number of *M. oleifera* root plants

Table 1 shows the average number of roots on each *M. oleifera* plant. Analysis of this table shows that there is a statistically significant difference between the different treatments at the 5% threshold (p = 0.032). The plants in the A1B2 treatment were the ones that had the most roots with an average of 5.33±3.79 roots/plant. However, the plants of the A4B3 treatment with an average of 1.333±0.577 roots/plant had, on the other hand, the lowest number of roots.

Effect of Treatments on Root Length of *M. oleifera* Plants

The average root length of *M. oleifera* plants is reported in Table 1. The analysis of this table shows that there is a statistically significant difference between the different treatments at the 5% threshold (p = 0.0415). In fact, the plants of the A1B3 and A3B2 treatments had the longest roots on average with 24.67±8.02a and 20.33±6.43 cm respectively.

Plants of the A1B1 and A2B2 treatments with average root lengths of 12.67±2.52 and 12.67±6.66 cm, however, have the shortest roots on average.

Effect of treatments on root diameter of *M. oleifera* plants

Table 1 shows the average diameter of *M. oleifera* plants by treatment. Analysis of variance shows that it has a statistically significant difference at the 5% threshold (p = 0.008). The treatments did not affect the average diameter of *M. oleifera* plants. The mean root diameter of *M. oleifera* plants is 2.04±0.23 cm. The Figure 1 below shows the roots of a *M. oleifera* plant.

Principal Component Analysis (PCA) and Provenance Grouping

The inertia explained by the F1 factorial axis is 41.5% while the F2 axis explains 20.3%. Examination of the F1 and F2 factorial plan from the scatter plot gives a total of 61.8%. This is enough to interpret the data.

Thus, the analysis of Table 2 shows that the variables LF (Leaf Length), lF_1 (Leaf Width), RBF (Fresh Biomass Yield) and DM (Dry Matter) and alternatively LP (Main Stem Length) are positively correlated with Axis 1. As for axis 2, it is positively correlated with the variable DP (Main stem diameter) and negatively with RBF (Fresh biomass yield), DM (Dry matter), LR (Root length) and DR (Root diameter).

It appears from the joint analysis of Table 2 and Figure 2 that the A1B1 and A1B2 treatments and to a lesser extent A1B3 are positively strongly correlated with axis 1 and are therefore characterized by long and broad leaves, a good yield of fresh biomass and dry matter and secondarily by a long main stem.

The A2B2 and A2B1 treatments are very well correlated with axis 2 and are, therefore, characterized by a very good diameter of the main stem, a poor yield of fresh biomass and dry matter and shorter roots and small diameter. The A2B3 and A3B2 treatments are confused or almost confused at the center of gravity and are, therefore, not very informative. It is worth highlighting the very particular character of the A1B1 individual, which suggests that it is by far the best treatment because it has led to the best results. The other treatments, namely A3B3, A4B1, A4B2 and A4B3, are opposed to A1B1 compared to F1. This testifies to the performances that are contrary to it. In other words, they are characterized by short and narrower leaves, a poor yield of fresh biomass and dry matter and by a rather short main stem.

In addition, the ascending hierarchical classification (HFC), with a level of similarity of more than 50%, suggests seven (7) groups which are G1 formed by the A1B1 treatment, the G2 group consisting of A2B1, A3B1, A3B2 and A2B3, the G3 group consisting of A4B1, the G4 group consisting of A2B2, the G5 formed by A4B2 and A3B3, group 6 with A1B2 and group 7 formed by A1B3 (Figure 4). The analysis of this figure shows that the A1B2 and A1B3 treatments are not only, by far, similar to A1B1 but also to each other as suggested by the PCA (Figure 3).

The germination rate reached one hundred percent (100%) on the 11th day after sowing. These results are consistent with those obtained by Amago *et al.*, (2006) who reported that seeds germinate uniformly after 10 to 14 days after sowing. This could be explained by nature or climatic conditions. According to Njehoya *et al.,* (2014), the lowest germination time is 10 days; This is less than the time given by Moringanews (2010) who obtained 12 days during his work. This is in line with the results of this study. Also, under the influence of certain climatic factors (temperatures, insolation, etc.), the germination time of moringa could be extended from 10 to 12 days (Njehoya *et al.,* 2014). The results of this study are also in line with those reported by CRA Dosso (2022). Which stipulate that the germination time is 7 to 10 days in the hot dry season and can be up to 14 days in the cold dry season. According to the same author, to speed up germination some growers shell the seeds by hand or soak them in warm water for 24 hours, this can reduce the germination time to 4 – 7 days in the hot dry season and 10 days in the cold dry season. Similar results were reported by Njehoya *et al.,* (2014) who used four (4) types of seed pretreatments, including control (non-pretreated seeds), scarified seeds, and finally seeds soaked in water for 36 and 72 hours respectively to facilitate germination.

The results of this study showed that treatment A1B1 where *M. oleifera* plants were given three (3) pinches of DAP mineral fertilizer and watered twice (2) a day, in the morning and evening, had the best growth of *M. oleifera* plants. This may be explained by the fact that *M. oleifera* is a species that tolerates high temperatures and precipitation quite well and tolerates a wide variety of soils (Fuglie and Sreeja, 2001). Also, the species grows well in humid climates and tolerates heavy irrigation. The results of this study are consistent with those of Ibrahim *et al.,* (2012). In assessing *Moringa oleifera* production on faecal sludge substrate as a function of fertilization and irrigation rate, the authors reported that the substrate that received the 1 L irrigation rate was statistically better than all types of substrates that received 0.5 L. The production of *M. oleifera* leaves is most important in the rainy season. This shows that *M. oleifera* is a long-day species and therefore likes sunny days. These results are in perfect harmony with the very origins of the species (Rabo, 2019). *M. oleifera* is a fast-growing plant native to northwestern India and the southern Himalayan Mountains, but grows well in tropical climates (Makkar and Becker 1996). The results of these studies corroborate those of this study. Similar results have also been reported by Phatu (2019). In fact, this author obtained a better yield with 300 ml containers, which are smaller than those that were used less. In addition, *M. oleifera* is a plant that grows well when it receives sufficient fertilizer. Indeed, the plants of the A1B1 treatment each received three (3) pinches of DAP, which allowed them to meet the fertilizer needs. This amount of DAP significantly improved the growth of *M. oleifera* plants. Similar results were reported by Yansoumba (2002) and Malo (2014) who showed that *M. oleifera* grows more after fertilizer application. The results of several authors (Agroconsult, 2016; Laurence, 2017) corroborate those of this study.

Indeed, these results stipulate that *M. oleifera* can certainly grow on all types of soil, but it is above all fertile and well-drained land that suits it. The yield of leaf biomass is highest with treatment A1B1. This is the result of frequent watering in sufficient quantities and fertilising that meets the needs of the plants. Similar results were reported by Malo (2014) for whom yield is strongly influenced by sowing density, irrigation, fertilization, phytosanitary treatment and crop maintenance. The results of this study included the number of roots per plant, the length and diameter of these roots. Indeed, the A1B2 treatment where the plants received three (3) pinches of DAP mineral fertilizer and were watered once (1) a day, in the morning are the ones that had more roots on average.

The longest roots were obtained with the A1B3 and A3B3 plants where the plants were watered once (1) in the morning every two (2) days. Plant roots are more influenced by water stress. Indeed, in case of stress, the roots prospect the most distant horizons. Cette situation est favorable à croissance en longueur des racines. Etant donné que les plants des traitements A1B3 et A3B3 sont arrosés chaque, matin et soir, l'eau est à la portée des racines et c'est qui justifierait la courte longueur des racines. The joint analysis of the ACP and the CAH highlighted seven (7) groups. The first, consisting mainly of treatment A1B1 where the *M. oleifera* plants received three (3) pinches of DAP mineral fertilizer and were watered twice (2) per day, is the one that gave the results for all growth and yield parameters. *M. oleifera* is a species that likes humidity as long as it has fertile soil and a high temperature. This corroborates the results of Fuglie and Sreeja (2001) who state that *M. oleifera* is a species that tolerates high temperatures and precipitation quite well and tolerates a wide variety of soils. Similar results have been reported by Malo (2014).

Table.1 Effects of Treatments on *M. oleifera* Growth and Yield Parameters.

Parameter	Length	Diameter	Number of sheets	Leaf length	Leaf width	Leaf biomass yield (g/plant)	Dry matter (g/plant)	Root length	Root diameter	Number of roots
A1B1	45±3[a]	1,4756±0,1024a	16,667±1,528a	25±1a	3,1337±0,0738a	25,808±1,661a	4,667±0,577ab	12,67±2,52b	2,017±0,184a	3±2ab
A2B1	42±9ab	1,1359±0,0801a	10,667±1,528d	21±3,61ab	2,854±0,227ab	20,97±2,7ab	3±0ab	15±6,08bc	1,805±1,805	2,667±1,528ab
A3B1	37,33±8,96b	1,2527±0,0801a	11±0cd	16,67±2,52bcd	2,6126±0,0826ab	21,41±2,32ab	3,333±0,577ab	16±2,65bc	1,805±0,368a	2,667±0,577ab
A4B1	41±7,81ab	1,3376±0,1592a	12,333±0,577bcd	13,67±3,21cd	2,4755±0,1684b	15,96±2,03b	2,667±0,577b	19±8,54ab	1,911±0,318a	2,667±1,528ab
A1B2	40±5ab	1,3482±0,1603a	13,333±1,155abcd	19,33±2,08abcd	2,6836±0,0771ab	25,78±0,506a	5,333±1,528a	16,33±2,08bc	2,123±1,024a	5,33±3,79a
A2B2	33,33±2,89c	1,38±0,1118a	14,333±0,577abc	17,667±0,577bcd	2,586±0,113ab	20,49±0,603ab	3,333±1,528ab	12,67±6,66b	2,07±0,421a	3,33±3,21ab
A3B2	47±3a	1,04±0,241a	13±1bcd	19,667±1,528abc	2,592±0,268ab	22,81±2,53ab	3,333±0,577ab	20,33±6,43a	1,911±0,318a	3,67±3,06ab
A4B2	35,33±5,03bc	1,008±0,239a	13,67±2,52abcd	13,333±0,577cd	2,2992±0,1004b	18,945±0,89ab	2,667±0,577b	18,33±2,31ab	2,442±0,368a	2,333±1,155ab
A1B3	40,67±10,07b	1,1783±0,0843a	13,333±1,155abcd	19±2,65abcd	2,7685±0,1121ab	27,426±1,648a	5±1ab	24,67±8,02a	2,548±0a	3±0ab
A2B3	39±1b	1,062±0,319a	13±1bcd	18±0,577bcd	2,5877±0,089ab	22,92±1,84ab	3,667±0,577ab	17,33±6,81bc	1,911±0a	4±1ab
A3B3	30±5c	1,093±0,175a	14,667±0,577ab	13±3,61d	2,4241±0,1053b	19,39±1,44ab	3±1,155ab	16,67±5,51bc	2,017±0,184a	3,33±3,21ab
A4B3	40,67±6,81ab	1,051±0,177a	12,333±0,577bcd	13,667±0,577cd	2,53±0,488b	21,58±2,03ab	3,667±1,155ab	19,67±4,04ab	2,017±0,184a	1,333±0,577b
p-value	0,0141	0,37	0,001	<0,0001	0,004	0,005	0,008	0,0415	0,437	0,032

Legend: ***Averages followed by the same letters are not statistically different***

Table.2 Correlation of variables with axes.

Variable	PC1	PC2
LP	0,262	-0,045
DP	0,297	0,319
NF	0,211	-0,033
LF	0,447	0,126
lF_1	0,436	0,146
RBF	0,412	-0,313
MS	0,411	-0,285
LR	-0,112	-0,599
DR	0,028	-0,565
NR	0,238	-0,006

Figure.1 Roots of a *M. oleifera* plant.

Figure.2 Principal Component Analysis (PCA) Factor Design.

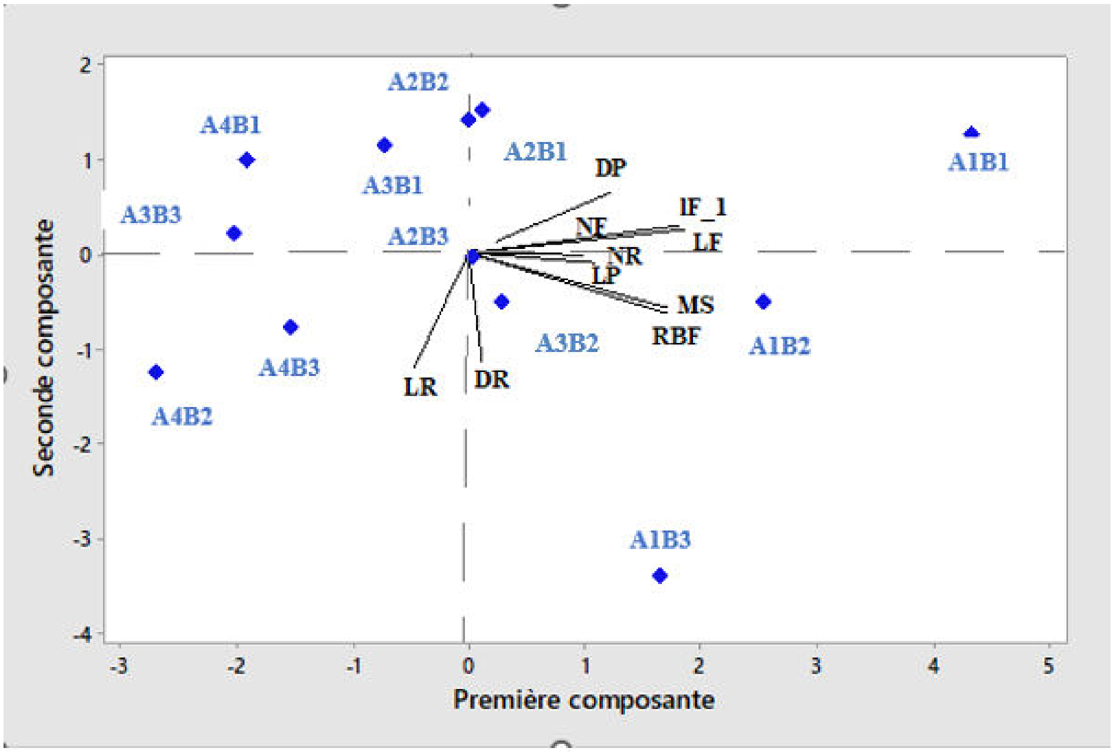
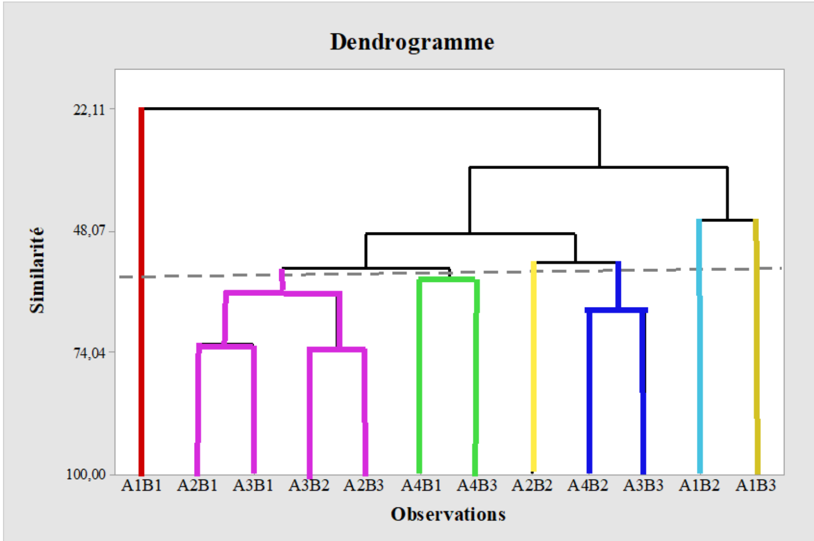


Figure.3 Dendrogram of treatments.



For this author, the yield is strongly in leaf biomass of *M. oleifera* influenced by sowing density, irrigation, fertilization, phytosanitary treatment and crop maintenance. According to Rabo (2019), the leaf biomass production of *M. oleifera* is higher in the rainy season than in the cold dry season. The G6 and G7 groups, formed respectively by A1B2 and A1B3, are the antithesis of the G1 group. This assumes that, even though these treatments appear similar in Figure 2, the HFC reveals that in reality they are very different from each other. This is because in the A1B2 and A1B3 treatments, the *M. oleifera* plants were watered once (1) daily in the morning and once (1) in the morning every two (2) days, respectively, while receiving the same amount of fertilizer as the other A1B1 treatments. *M. oleifera* plants, in the A1B2 and A1B3 treatments, require more water because of this amount of fertilizer. However, *M. oleifera* is a water-demanding species and this water cannot be available in these treatments.

This study was conducted in the commune of Diffa, on the combined effects of different doses of DAP mineral fertilizer (18% N and 46%P) and watering frequency on the initial growth of *Moringa oleifera*. It showed that treatment A1B1 where *M. oleifera* plants received three (3) pinches of DAP mineral fertilizer and were watered twice (2) per day had the best results for all growth and yield parameters. However, treatment A4B1 where *M. oleifera* plants received no dose of DAP mineral fertilizer and were watered twice (2) per day had the lowest yield of leaf biomass. The ACP revealed that the A1B1 and A1B2 treatments and, to a lesser extent, A1B3 are characterized by long and wide leaves, a good yield of fresh biomass and dry matter and secondarily by a long main stem, while the A2B2 and A2B1 treatments are characterized by a very good diameter of the main stem poor yield of fresh biomass and dry matter and shorter roots with a small diameter. The CAH suggested seven (7) groups which are G1 made up of A1B1 treatment, G2 made up of A2B1, A3B1, A3B2 and A2B3, G3 made up of A4B1, G4 made up of A2B2, G5 made up of A4B2 and A3B3, group 6 with A1B2 and group 7 made up of A1B3. At the end of this study, it is advisable to propose to the producers to use three (3) pinches of DAP fertilizer and to water the plants two (2) times a day for a better production of leaf biomass of the species.

Author Contributions

Rabo Younoussou: Investigation, formal analysis, writing—original draft. Mahamane Ali: Validation, methodology, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

References

Agroconsult H. (2016). Analyse des Potentialités de l'Exploitation du Moringa en Haïti. Ministère de l'Agriculture, des Ressources Naturelles et du Développement Rural (MARNDR), Banque de la République d'Haïti (BRH), Rezo Moringa Dolivayiti, Haïti, 187 p.

Alhado, A. I. (2014). *Analyse fonctionnelle des systèmes agroforestiers à base de Moringa oleifera. Lam ; vertus et rôles socioéconomiques du Moringa : cas du site maraicher de Jirataoua*. Mémoire de master, Université DAN DICKO Dankoulodo de Maradi. 40 p.

Amaglo, N.K., Timpo, G.M.,Ellis W.O and Bennett,R.N. (2006). Effet de l'écartement et la fréquence des récoltes sur la croissance et le rendement en feuilles de *Moringa oleifera* Lam. Moringa et autres végétaux à fort potentiel nutritionnel : Stratégies, normes et marchés pour un meilleur impact sur la nutrition en Afrique. Accra, Ghana, 16-18novembre 2006. 11p

Broin, M. (2010). Diagnostc préalable à la sensibisation. CTAACPUE. http://www.moringanews.org

Bonkoungou, E. G., (2001). Production et commercialisation des feuilles de Moringa en Afrique Occidentale étude de cas au Niger. In Potentiel de développement des produits du Moringa 29 octobre - 2 novembre 2001, Dar es Salaam, Tanzanie.

CNRA (2022). Banque alimentaire à base de *Moringa oleifera* Lam. Par semis direct. Recueil de fiches techniques. 3 p

Foidl, N., Makkar, H. S. et Becker, K., (2001). Potentiel de *Moringa oleifera* en agriculture et dans l'industrie. Actes du séminaire sur *Moringa oleifera* du 29 octobre au 2 novembre 2001, Dar es Salaam, Tanzanie. 57p.

Fuglie, L.J. and Sreeja K.V., (2001). Cultivation of *Moringa oleifera* In: Fuglie, L. J. (ed.). The miracle tree, the multiple attributes of Moringa. Pp. 153-158.

Gamatié, M. (2006). Feuilles de Moringa et autres végétaux à forts potentiel nutritionnel: stratégies, normes et marchés pour un meilleur impact sur la nutrition en Afrique. Atelier international Accra, Ghana. 10p

Ibrahim, S. S., Mahaman, M. A., Abdourahmane T. D. B. and Zaleyha, A. B. (2021). Evaluation de la production du *Moringa oleifera* Lam. sur substrat constitué de boue de vidange en fonction de la fertilisation et de la dose d'irrigation. *Int. J. Biol. Chem. Sci.* 15(6): 2417-2425. DOI : https://dx.doi.org/10.4314/ijbcs.v15i6.14

Laurence, R. (2017). *Valorisation des légumes Feuilles et introduction de Moringa oleifera chez les maraîchers de Toliara*. Mémoire de diplôme d'études approfondies (DEA) en Biodiversité et Environnement, Option Biologie végétale, Université de Toliara, Madagascar, 63 p.

Makkar, R.H.P.S. and Becker K. (1996). Nutritional value and anti-nutritional components of whole and ethanol extracted Moinga oleifera leaves. *Animal Feed Science technology*. 63, 211-228.

Malo, T. (2014). *Effet de la fertilisation sur la croissance et la production de Moringa oleifera local et Moringa oleifera PKM-l dans la Région des Cascades*. Mémoire de fin de cycle pour l'obtention du diplôme de Master en productions végétales. Université Polytechnique de Bobo Dioulasso, Burkina Faso, 68 p.

Mawouma, S. and Mbofung, C.M. (2014). Usages alimentaires de *Moringa oleifera* dans la région de l'Extrême-Nord Cameroun. *J. Biol. Chem. Sci*. 8(4): 1847-1852.

Moringanews/Moringa Association of Ghana. 2010. Growing and processing moringa pp 17-19

Njehoya, C.A, Sali B., Ko Awono, P.M.D, Hamadou B. (2014). Évaluation du potentiel de germination de *Moringa oleifera* dans la zone soudano-guinéenne du Cameroun. *J. Appl. Biosci*. 74:6141– 6148

Rabo, Y. (2019). *Structures, fonctionnement et perspectives d'amélioration des Systèmes Agroforestiers à base de Moringa oleifera Lam. dans les vallées du Fleuve Niger et du Goulbi de Maradi au Niger*. Thèse de doctorat, Université Dan Dicko Dankoulodo de Maradi, Niger, 152 p

Phatu, W.M. (2019). Responses of *Moringa oleifera* root growth to container size during overwintering in temperate regions. *African Journal of Agricultural Research*, 14(2): 65-68. DOI: 10.5897/AJAR2016.11667

Yansoumba B. 2002. *Possibilités d'utilisation des eaux usées dans la production forestière : cas de Leptadenia hastata et de Moringa oleifera*. Mémoire de fin d'études, ITA, Faculté d'Agronomie de l'Université Abdou Moumouni de Niamey, Niger, 37 p.

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