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Research Article

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# Agronomic Efficacy of Faidherbia Albida Leaf Litter Combined with Organic Manure on Sorghum (Sorghum Bicolor) Growth and Yield

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**ABSTRACT**

*Sorghum is an essential plant in Africa, it is the second most widely grown cereal after millet. However, soil degradation such as deforestation, improper land management practices, and climate change, pose a threat to the optimal growth and yield of sorghum. Therefore, the utilization of organic amendments in agriculture is gaining prominence as a sustainable strategy to enhance crop yields while simultaneously promoting soil health. The aim of this study is to assess the effect of combining Faidherbia albida leaf litter and manure on sorghum growth and yield. A completely randomized block design with five treatments and three replications was used. The treatments were the control (T0), Faidherbia leaf litter (T1) 5T/ha, the recommended rate of inorganic fertilizer (NPK (15:15:15) 150kg/ha and Urea 100kg/ha) (T2), farmers'farmer's practice (manure) (T3) and the combination of F. albida litter and manure (T4). The results show that the organic amendments (T1, T3 and T4) gave the best performance in terms of sorghum growth and production parameters, with grain yields of 2.669 T/ha for T1, 2.477 T/ha for T3 and 2.327 T/ha for T4. However, the recommended rate of NPK had a positive influence on growth parameters but gave an average yield (1.134 T/ha) which was lower than the yield potential of sorghum (2 to 3 T/ha). The control treatment recorded the lowest seed yield with only 0.542 T/ha. The combination of litter and manure recorded the highest values for plant height, number of leaves, crown diameter and sorghum yield. Therefore, the combination of Faidherbia litter and manure could constitute a sustainable alternative to the use of chemical fertilizers for sorghum production.*

## INTRODUCTION

Sorghum is one of the main cereals grown in arid and semi-arid tropical regions (Djè *et al.* 2007). It is the world's 5th most important cereal after maize, rice, wheat, and barley (Chantereau *et al.* 2013, FAOSTAT 2015). In Africa, sorghum is a staple food for millions of people (Agram Agrama and Tuinstra 2003, Ba *et al.* 2010). In Senegal, it occupies a prominent place alongside millet in Eastern Senegal and Upper Casamance, where they cover more than half the area sown to cereals (Fofana *et al.* 2009). Sorghum is one of the mainstays of subsistence farming (Ba *et al.* 2010). However, despite the importance of this crop yields remain low with an average production of around 0.939 t/ha (FAOSTAT, 2015). In Senegal, cereal production faces several constraints such as poor cultivation techniques, attacks by pests and infection by weeds (Striga, insects, *etc.*), poorly known productive varieties, climatic deteriora-

tion, and drought, poorly fertile and threatened soil resources (Soumana, 2001), as well as a lack of knowledge about the optimal sowing period. that lead to low yields. In addition, the excessive use of chemical fertilizers exacerbates the low production of cereals crops (Ndiaye 2015). This intensive, low organic input agriculture, with no recycling of crop residues, results in negative nutrient balances and cannot maintain soil fertility in the long term. Added to this is a decline in the land's production potential due to poor farming practices (monoculture, non-rational use of chemical fertilizers, low input of organic matter) that fail to integrate soil fertility as a production factor. There is therefore an urgent need to combat declining soil fertility with productive and environmentally friendly farming practices.

Therefore, a key element in the nutrient management strategies of smallholder and resource-constrained farmers should be the application of organic amendments to provide plants with nutrients, enhance crop yields, and improve overall soil health. Previous studies have demonstrated that using plant litter and manure together can result in higher and more sustainable crop yields than using inorganic fertilizers alone. Testing the effects of litter-manure mix, however, is crucial to supplying the nutrients needed for higher sorghum yields, less pollution in the environment, and improved food security. Furthermore, the use of organic inputs such as plant residues, compost or manure can affect yields independently of the initial organic matter content (Oldfield *et al.* 2015). These organic inputs are an alternative more in line with farmers' socio-economic conditions (Manssour *et al.* 2014). Setting up an agroforestry system with the use of fertilizer species like is also an option for overcoming declining soil fertility and low agricultural production. The integration of trees plays a very important role in cropping systems. The advantage of this integration in production systems has been highlighted by several authors (Boffa 2000, Diallo *et al.* 2008, Camara 2018). It enhances soil fertility and increases production.

The overall aim of this study is to restore soil fertility and help improve sorghum production through ecological solutions. Specifically, it aims to study the effects of combining *Faidherbia albida* leaf litter and manure on sorghum growth and yield.

## MATERIALS AND METHODS

### Site description

The study was carried out during the 2021 rainy season at the application farm of the Agroforestry Department of the Assane SECK University of Ziguinchor (UASZ). It is located at 12°33'N latitude and 16°16'W longitude in the commune of Ziguinchor, with a surface area of 1.3 ha. The study area is in the Ziguinchor region. The area of the region is 7399km² or 3.73% of the national territory (ANSD 2013). This region is marked by a southern coastal Sudanian climate (Sagna 2016), an average temperature of 27.10° and with rainfall ranging between 1300 and 1500 mm (Dasylva *et al.* 2017).

### Experimental design

A completely randomized block design with three (3) replicates (blocks) was set up. Each block covered an area of 14.25 m² (9.5 m×1.5 m) and was made up of five (5) elementary plots. Each elementary plot corresponds to a treatment. The factor studied was fertilization, with five treatments compared. The five treatments are control (nutrient-poor sand with any fertilization) (T0), *Faidherbia albida* litter =200g/ containers (T1), conventional practice (NPK (15-15-15) = 5g/containers 15 DAG (Days after germination)+ Urea (CO (NH2)2) dosed at 46% N (T2), farmer's practice with 1kg/godet (T3), *Faidherbia albida* litter + organic fertilizer = 200g *Faidherbia albida* litter and 1 kg organic fertilizer (T4). The distance between blocks is 1 m and that between individual plots is 0.5 m. Each elementary plot covers an area of 2.25 m² (1.5 m×1.5 m) and is made up of six (6) buckets.

### Organic fertilizers Faidherbia albida leaf litter

*F. albida* leaf litter was collected from the trees. It is composed of leaves, peduncles and thorns. Once collected, the litter was dried in the shade for two weeks. After drying the leaves and peduncles were sorted and separated from the thorns

### Cow manure

The dried cow manure was collected and composted over a three-week. The characteristics of the cow manure are recorded in the following table.

### Agronomic management

The sorghum variety used as seed is Nguinthe. *F. albida* leaf litter was collected from trees around the university. It consists of leaves, peduncles, and spines. Once collected, the litter was placed in bags and stored in a cool, sunny place for two weeks. After drying, the leaves were separated from the thorns and small twigs.

**Table 1: Biochemical composition of *Faidherbia albida* leaf litter (Diallo *et al.*, 2019)**

| Organic matter | Soluble phenols (mg g-1) | Lignin | Cellulose (%) | Hemi-cellulose | Organic carbon (C) (mg g-1 DM) | Total nitrogen (N) | C/N |
|---|---|---|---|---|---|---|---|
| *Faidherbia albida* | 7.1 | 21.3 | 19.6 | 11.3 | 428.3 | 20 | 21.4 |

The equipment used during the preparatory work included cutters, rakes, and hoes. These were used to clean the space in which the experimental set-up was to be installed. Plastic cups measuring 15 cm by 14 cm with a volume of 3L were used as containers during the study. A mosquito net was placed at the bottom of each bucket to prevent sand leaching from the holes.

### Conduct of the trial

The system was installed over an area of 61.75 m² (9.5 m×6.5 m). It consists of a total of ninety (90) buckets. Before placing the buckets, five (5) centimeter holes were dug to contain the buckets. Cups for treatments T1, T3 and T4 were filled with 200g *F. albida* leaf litter + sand, 1kg manure +sand, 200g *F. albida* leaf litter + 1 kg manure + sand. These buckets were incubated for 45 days. The mixtures were moistened and turned over every 5 days to accelerate decomposition of the litter and manure. Treatments T0 and T2 were filled with sand. After the incubation period, sowing was carried out with three (3) seeds per bucket. The seedlings were removed fifteen (15) days after planting, leaving one seedling per bucket. After the rainy season, watering was carried out twice a day in the morning and evening until the end of the study.

### Data collection

Various observations and measurements were made every 15 days from the 21st day after emergence on each treatment for the following parameters number of tillers; number of leaves, diameter at collar measured with a caliper; master strand height measured with a decameter; 50% flowering and maturation date, grain yield was determined at harvest for each treatment using the following formula: dry grain weight of each treatment/area per hectare of each treatment. The root length is measured at the end of the study and after root cleaning, above-ground and root biomass were dried in the open air by repetitive weighing until the mass was constant. Dry above-ground and root biomass was determined by cumulating the mass of all plants in the same elementary plot.

### Extraction and measurement of chlorophyll

Leaf samples were collected in the morning (06:00), wrapped in aluminum foil and immediately chilled before being taken to the lab. Three samples were taken from each elementary plot, making a total of 45 samples. The 100 mg leaf mass for each sample was ground to extract all chlorophyll pigments in a 10 ml solution of 80% acetone, then incubated in tubes for 24 hours at 4°C.

**Table 2:** Characteristics of cow manure (Diop *et al.*, 2019)

| Characteristics | |
|---|---|
| pH | 8.14 |
| Electric conductivity (us/cm) | 239 |
| Humidity (%) | 32 |
| Carbon (%) | 135.2 |
| Nitrogen (%) | 16.1 |
| C/N | 8.38 |
| Organic matter (%) | 232.20 |
| Phosphore (ppm) | 643.01 |
| CEC (meq/100 g) | 111.11 |
| Ca (meq/100 g) | 10.83 |
| Mg (meq/100 g) | 2.48 |
| Na (meq/100 g) | 0.58 |
| K (meq/100 g) | 2.22 |

Chlorophyll content was determined using the method described by Makeen *et al.* (2007). After 24h, the absorbance of the total supernatants (Chl a, Chl b and carotenoids) for each sample was measured at 663 nm, 645 nm and 470 nm respectively using a spectrophotometer and a blank control made with 80% acetone alone. The spectrophotometer showed the absorbance of all three pigments at the same time. Chlorophyll (a, b and a+b) and carotenoid contents were calculated according to Arnon (1949) formulas:

Chl a (mg $L^{-1}$) = [12.7 × DO (663 nm) – 2.59 × DO (645 nm)] ×

Chl b (mg $L^{-1}$) = [22.9 × DO (645 nm) – 4.68 × DO (663 nm)] ×

Chl t (mg $L^{-1}$) = [8.02 × DO (663 nm) + 20.2 × DO (645 nm)] ×

Chl t = Chl a + Chl b

Chl: Chlorophyll content

Caroténoïde (mg $L^{-1}$) = [4.695 × DO (470 nm) – 0.268 (Chl a + Chl b)] ×

### Statistical analysis

The data collected was entered into an EXCEL spreadsheet. To process the data, R software version 4.2.2 was

**Table 3:** Effects of treatments on sorghum height

| Treatments | 21DAG | 36DAG | 51DAG | 66DAG | 81DAG |
|---|---|---|---|---|---|
| T0 | 20.20±5.45 c | 32.66±6.88 c | 47.33±6.96 b | 62.66±7.62 d | 73.83±11.88 d |
| T1 | 50.77±6.29 b | 79.06±9.52 b | 105.27±14.63 a | 139.38±23.38 b | 147.66±23.01 b |
| T2 | 21.65±5.77 c | 39.28±16.07 c | 59.80±18.49 b | 98.05±24.64 c | 114.17±30.96 c |
| T3 | 48.98±8.93 b | 86.20±12.30 a | 116.44±20.53 a | 157.38±20.23 a | 161.72±13.53 a |
| T4 | 57.60±6.29 a | 90.46±13.78 a | 114.93±26,05 a | 143.63±24.77 b | 147.77±19.94 b |
| Mean | 39.84 | 65.52 | 88.75 | 120.22 | 129.03 |
| Probability | 7.41e-14 | 2.51e-13 | 7.10e-13 | 2.46e-12 | 2.88e-11 |
| Significant | VHS | VHS | VHS | VHS | VHS |

*Legend: T0=control, T1=Faidherbia litter, T2=conventional practice, T3=farming practice, T4=Faidherbia +Manure, DAG=day after germination, VHS=very highly significant.*

used, with a significancVe level of 5%, for normality, Kruskal and ANOVA Mtests. Results are considered significant when pV ≤ 0.05, highly significant when p < 0.001 and veryMhighly significant when p < 0.0005.

## RESULTS AND DISCUSSIMON

### *Plant height, number of leaves and collar diameter*

Table 3 shows the effect of the amendmeVnts on height growth. An evolution of average plant Mheight with a highly significant difference between treatments at each measurement date was noted. From the 21stDAG to the 51stDAG, the greatest average heights were obtained with treatments T1, T3 and T4 compared with treatments T0 and T2. However, there was a highly significant difference between T3 and the other treatments at dates 66thDAG (p=2.46e-12) and 81stJAL (p=2.88e-11). The lowest mean height was observed with T0 (73.83 cm ±11.88) and the highest with T3 (161.72 cm ±13.53).

The effect of the different amendments on the variation in leaf number is shown in Table 4. The table shows that the treatments are statistically different. At the dates 21stDAG (p=1.16e-09) and 36thDAG (p=1.10e-10), the test applied shows a very highly significant difference between the organic amendments (T1, T3 and T4) compared with conventional practice (NPK+urea) and the control. From the 51stDAG onwards, plants subjected to treatment T2 had the highest number of leaves (19.47±11.39 leaves). However, by the 81st JAL, there was a highly significant difference (p=0.0048) between the sources of variation and the control. The highest average number of leaves was obtained with plants subjected to conventional practice (T2) with 24.23±19.29 leaves. Control plants gave the lowest average number of leaves (11.22±10.90 leaves).

Mean crown diameter is shown in Table 5. The kruskal test performed on the crown diameter data revealed a very highly significant difference (p<0.0005) between treatments throughout the study. The organic amendments (T1, T3 and T4) produced plants with the largest mean diameters of 1.76±0.24 cm, 1.72±0.27 cm and 1.68±0.27 cm respectively at all measurement dates. However, the T2 treatment had a significant effect on average plant diameter compared with the control plants. The smallest mean diameter was observed on the control (0.99±0.34 cm).

The amendments used had various effects on sorghum growth. Results on the number of leaves, collar diameter, height of master strand showed that organic amendments (*Faidherbia* litter, manure, and Faidherbia + Manure) gave the best results. This could be explained by the chemical composition of the amendments used. Organic manure ensures the availability of certain nutrients such as phosphorus, while litter ensures the availability of nitrogen following its decomposition. These two major elements are essential for good plant growth. A study by Chantereau *et al.* (2013) showed that all sorghum fertilization must be based on nitrogen (N) and phosphorus (P). Our results concur with those of Nacro (2018) who indicated that organic matter constitutes an additional source of nutrients useful for plant growth. Studies by Ayoola and Makinde (2008), Mulaji (2011) and Maman and Mason (2013) support these results as they have shown that organic amendments improve the chemical properties of the soil making them favorable for crop growth. Similarly, the combination of *F. albida* litter and manure positively influenced growth and yield parameters. These results are in line with those of Mallouhi and Bioyara (1997), who demonstrated the positive effects of combining *Leuceana leucocephala* prunings and cattle manure on maize. However, it is important to point out that the results generally show a significant increase in plant growth in the presence of mineral fertilizers (NPK+urea), which may be due to the immediate availability of nutrients following mineral fertilization. Our results corroborate those of Bationo *et al.* (2004) who demonstrated the significant effect of chemical fertilization on maize. The performances obtained

**Table 4:** Effects of treatments on the number of leaves

| Treatments | 21DAG | 36DAG | 51DAG | 66DAG | 81DAG |
|---|---|---|---|---|---|
| T0 | 3.50±0.85 c | 4.27±0.46 d | 5.38± 2.14 c | 8.27±8.83 c | 11.22±10.90 b |
| T1 | 5.72±2.94 b | 8.11±2.60 b | 11.27±5.26 b | 15.05± 9.30 ab | 19.77±11.15 a |
| T2 | 3.77±1.11 c | 7.16±4.13 c | 19.47±11.39 a | 20.41±10.75 a | 24.23±19.29 a |
| T3 | 6.00±1.71 ab | 8.33±1.57 b | 11.88±4.66 b | 13.00±6.55 b | 15.61±10.55 a |
| T4 | 7.66±5.56 a | 10.27±3.90 a | 13.55±7.30 b | 15.38±12.15 b | 16.61±14.27 a |
| Mean | 5.33 | 7.628 | 12.31 | 14.422 | 17.488 |
| Probability | 1.16e-09 | 1.10e-10 | 2.92e-08 | 2.60e-06 | 0.0048135 |
| Significant | VHS | VHS | VHS | VHS | HS |

*Legend: T0=control, T1=Faidherbia litter, T2=conventional practice, T3=farming practice, T4=Faidherbia +Manure, DAG=day after germination, VHS=very highly significant, HS=highly significant.*

**Table 5:** Effects of treatments on sorghum crown diameter

| Treatments | 21DAG | 36DAG | 51DAG | 66DAG | 81DAG |
|---|---|---|---|---|---|
| T0 | 0.15±0.07 c | 0.33±0.07 e | 0.50±0.15 c | 0.87±0.30 c | 0.99±0.34 c |
| T1 | 0.62±0.11 b | 1.18±0.17 c | 1.72±0.31 a | 1.76±0.29 a | 1.76±0.24 a |
| T2 | 0.19±0.09 c | 0.75±0.34 d | 1.04±0.49 b | 1.36±0.35 b | 1.45±0.39 b |
| T3 | 0.66±0.15 b | 1.36±0.25 b | 1.83±0.32 a | 1.71±0.24 a | 1.72±0.27 a |
| T4 | 0.83±0.14 a | 1.47±0.17 a | 1.76±0.24 a | 1.70±0.2 a | 1.68±0.27 ab |
| Mean | 0.49 | 1.018 | 1.37 | 1.48 | 1.52 |
| Probability | 1.25e-14 | 1.25e-13 | 1.82e-11 | 1.78e-08 | 6.18e-07 |
| Significant | VHS | VHS | VHS | VHS | VHS |

*Legend: T0=control, T1=Faidherbia litter, T2=conventional practice, T3=farming practice, T4=Faidh+Manure, DAG=day after germination, VHS=very highly significant,*

with organic soil improvers are favorable in terms of both water and chemicals.

### *Number of tillers*

The evolution of the number of tillers according to treatments is shown in Table 6. It shows that from the 21stDAG (p=0.25) to the 36thDAG (p=0.16) there is no significant difference between treatments. From the 51stJAL to the 81stJAL, the treatments were highly significant (5.24e-07; 4.39e-08), with the highest average number of tillers obtained with plants subjected to T2. However, at the last measurement date (96th DAG), the analysis shows that there is no significant difference (P=0.1920379) between treatments. In terms of absolute value, T4 plants produced the highest average number of tillers (7.72±6.65). The lowest average number of tillers was obtained with the control (T0) with 4.33±5.47 tillers. The results showed that organic amendments had a significant effect on the number of tillers from the 81st JAL, while mineral fertilization had a positive effect from the 51st JAL. This delay can be explained by the speed of mineralization of the organic amendments. Indeed, the constituents of organic amendments are not directly available to plants (Segnou *et al.* 2012). Culot (2005) showed that it took 7 months for the effect of litter to be significant.

### *50% flowering and maturation dates, pigment content and root length*

Table 7 shows that the 50% flowering date varied very significantly (P=7.73e-07) between treatments. As for the 50% maturation date, it varied between treatments, but only significantly (p=0.0114204). Treatments T4, T3 and T1 reached 50% Flowering at 56thDAG, 58th DAG and 64th DAG respectively. Fifty percent (50%) of the plants in these treatments reached maturity first at 91st DAG. Delayed flowering (89th DAG) and delayed maturation (110th DAG) were observed on the controls.

In terms of chlorophyll pigments (CHt and carotenoids), there was a significant difference between treatments. T4 plants showed the highest average amounts of CHt (5.01±0.51 mg L-1) and carotenoids (1.17±0.19 mg L-1). The lowest average amounts of CHt (2.42±0.86 mg L-1) and carotenoids (0.66±0.22mg L-1) were obtained with T0. About root length, no significant difference was observed between treatments (p=0.2156).

In chlorophyllous plants, the chlorophyll content of leaves provides information on the physiological status of the plant (Gitelson *et al.* 2003). Analysis of the results relating to the quantity of chlorophyll pigments shows that plants amended with the litter and manure combination (T4) yielded the highest quantities of total chlorophyll and carotenoid. This may be explained by the high nitrogen (N) content of *Faidherbia* litter, which is a constituent of the chlorophyll molecule. These results are identical to those of Boutchich *et al.* (2016) who showed that the incorporation of nitrogen-rich

**Table 6:** Evolution of the number of tillers according to treatments

| Treatments | 21DAG | 36DAG | 51DAG | 66DAG | 81DAG | 96DAG |
|---|---|---|---|---|---|---|
| T0 | 1.00±0.00 b | 1.00±0.00 b | 1.22±0.64 c | 1.16±0.51 b | 2.22±3.42 c | 4.33±5.47 b |
| T1 | 1.33±1.18 ab | 1.11±0.47 ab | 1.38±1.24 c | 1.88±1.60 b | 3.44±2.63 ab | 7.16±5.05 a |
| T2 | 1.11±0.32 ab | 1.44±0.92 a | 4.17±2.37 a | 4.17±2.29 a | 5.23±4.10 a | 7.29±7.06 ab |
| T3 | 1.27±0.57 ab | 1.11±0.47 ab | 1.88±1.02 b | 1.22±0.64 b | 1.94±1.58 c | 7.61±6.19 a |
| T4 | 1.61±1.46 a | 1.33±0.84 ab | 2.00±1.08 b | 1.55±1.19 b | 2.55±2.70 bc | 7.72±6.65 ab |
| Mean | 1.264 | 1.198 | 2.13 | 1.996 | 3.076 | 6.822 |
| Probability | 0.25 | 0.16 | 5.2489e-07 | 4.391e-08 | 0.00044 | 0.1920379 |
| Significant | NS | NS | THS | THS | THS | NS |

*Legend: T0=control, T1=*Faidherbia *litter, T2=conventional practice, T3=farming practice, T4=Faidherbia +Manure, DAG=day after germination, VHS=very highly significant, NS=not significant.*

**Table 7:** Effects of treatments on 50% flowering and maturation dates, pigment levels and root length

| Treatments | 50% Flowering (DAG) | 50% Maturation (DAG) | Pigment levels ( mg.L-1) | | Root length (cm) |
|---|---|---|---|---|---|
| | | | CHt | carotenoids | |
| T0 | 89±3 a | 110±3 a | 2.42±0.86 c | 0.66±0.22 b | 45.72±12.14 b |
| T1 | 64±2 c | 91±1 c | 3.32±1.69 bc | 0.92±0.32 b | 49.77±7.30 ab |
| T2 | 80±3 b | 100±2 b | 3.51±0.79 bc | 0.86±0.08 b | 49.52±9.81 ab |
| T3 | 58±4 c | 91 ±0 c | 3.56±1.41 b | 0.86±0.27 b | 52.50±15.06 ab |
| T4 | 56±3 c | 91±0 c | 5.01±0.51 a | 1.17±0.19 a | 51.86±9.41 a |
| Probability | 7.73 e-07 | 0.0114204 | 0.0012 | 0.00162 | 0.2156 |
| Significant | VHS | S | S | S | NS |

*Legend: T0=control, T1=Faidherbia litter, T2=conventional practice, T3=farming practice, T4=Faidherbia +Manure, DAG =day after germination, VHS=very highly significant, S=significant, NS=not-significant*

compost increases the chlorophyll content of leaves. In terms of root length, there were no significant differences between treatments. This may be explained by using 3L cups to condition the sorghum plants. As sorghum is a crop with a powerful root system, the use of buckets constitutes a physical barrier to root development. The work of Boutchich *et al.* (2016) has shown that the use of pots for wheat cultivation leads to root overlapping and therefore root growth will be limited.

### *Sorghum yield, Aboveground and root biomass, 1000-grain weight*

Figure 2 shows the variation in average yield between treatments. Analysis shows a significant difference between treatments (p=0.00586). There was no significant difference between the organic amendments (T1, T3 and T4), with respective average yields of 2.669±0.918 T/ha, 2.477±0.637 T/ha and 2.327±0.705 T/ha. However, treatment T2 influenced average yield (1.134±0.310 T/ha) compared with the control (0.542±0.180 T/ha). Table 6 shows the variation in above-ground and root biomass between treatments. Statistical analysis shows a significant difference between treatments for above-ground and root biomass. T1 plants yielded the highest above- ground (448±285.24 g) and root (760±242.48 g) biomass values. However, there was no statistical difference between the organic amendments (T1, T3 and T4) for above-ground and root biomass. It should be noted that treatments T2 and T0 are not statistically different for root biomass. In terms of absolute values, T0 yielded the lowest quantities of above-ground biomass ( 448 ± 285 . 24 g) and root biomass (181.33±65.91 g). Regarding the variation in 1000- grain mass between treatments represented by the figure 3, The analysis shows that treatments T1, T3 and T4 gave the highest 1000-grain masses, with values of 27.9 g, 30.98 g and 28.94 g respectively. Treatment T0 gave the lowest 1000-grain mass.

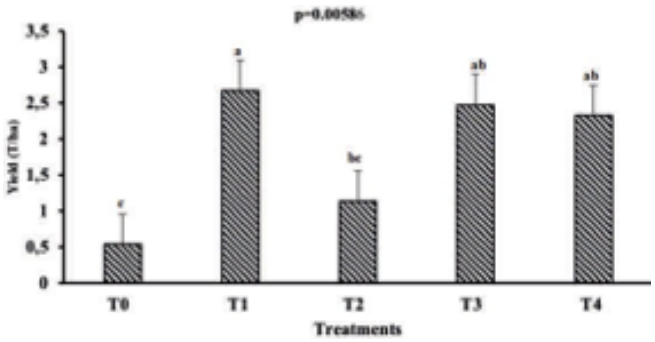



**Figure 2:** Variation in average yield as a function of treatments

**Table 8:** Effects of treatments on above-ground and root biomass

| Treatments | Above ground biomass (g) | Root biomass (g) |
|---|---|---|
| T0 | 448±285.24 b | 181.33±65.91 b |
| T1 | 1580.66±494.81 a | 760±242.48 a |
| T2 | 861.33 ±32.08 ab | 342.66±55.14 b |
| T3 | 1410.66 ±485.83 a | 689.33± 48.83 a |
| T4 | 996.66 ±314.10 ab | 431.33±223.18 ab |
| Probability | 0.0229 | 0.00494 |
| Significant | S | S |

*Legend: T0=control, T1=Faidherbia plantation, T2=conventional practice, T3=farming practice, T4=Faidherbia +Manure, S=significant*

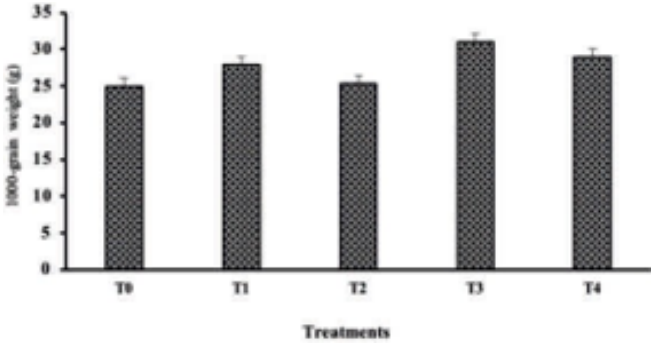



**Figure 3:** Variation in the mass of 1000 grains as a function of treatments

The results obtained on these parameters can be explained by the fact that organic amendments increase total soil C and N levels, though not measured in the current study, can be attributable to variations in seed yields between organic additions and inorganic fertilizers, with the effects lasting up to four years. Furthermore, adding organic amendments to soils may raise the levels of P, K, Mg, and Ca, which would account for the higher yield of sorghum. Manure plays a key role in altering the soil exchange capacities, as evidenced by studies examining the effects of organic amendments on crop productivity and soil fertility. Manure and compost-amended soils have been shown to have a significantly higher cation exchange capacity than non-amended soils. Higher exchangeable Ca concentrations were found for all organic amendments, indicating that the Ca from organic materials accounts for most of the soils' exchange ability. Furthermore, the addition of organic amendments like leaf litter and animal manure may free up exchange sites in the soil particles by binding cations in the soil solution, increasing the concentration of nutrients. Increasing the C levels in the soil by applying organic amendments may result in more stable humic complexes and a greater soil adsorption capacity. Enhancement of moisture retention in the small pore size of more stable humic complexes can also lead to a stronger stimulation of microbial-mediated release of nutrients.

On the other hand, the results obtained on these parameters could be explained by the role of organic amendments on soil physical properties. Over the course of the study, buckets containing organic amendments showed faster infiltration and good water retention capacity compared with buckets containing mineral fertilizers and the control. This could be due to the improvement in soil pores following the addition of organic matter. In addition, the improvement of soil pores by organic amendments enables plants to develop their root systems and can probably use the nutrients they need to grow (Dridi and Toumi 1999). In general, organic matter physically retains more water than mineral soil compounds (sand, silt, and clay), thus increasing soil water retention (Evanylo and Mcguinn 2000).

Numerous studies have demonstrated that using manure might provide legume crops with most of the N they need while also yielding more than just applying synthetic fertilizers. These results imply that seed yields from sorghum agriculture can be on par with or higher than those from mineral fertilizers when organic additives are used sparingly. Thus, by reducing reliance on inorganic fertilizers and increasing crop output, organic amendments can reduce the dangers associated with excessive and improper use of synthetic fertilizers.



**Figure 1**

## CONCLUSION

The aim of this study was to investigate the effects of combining *Faidherbia albida* leaf litter and manure on sorghum growth and yield. The results showed that the incorporation of manure and *Faidherbia* leaf litter alone, or their combination, resulted in a greater increase in growth parameters. Yields obtained with *F. albida* litter (2.669T/ha), manure (2.477T/ha) and their combination ( 2 . 327 T/ ha) reached the productivity range of the Nguinthe sorghum variety (2 to 3T/ha). Although its yield (1.134T/ha) did not reach this range,

the chemical fertilizer showed satisfactory results on growth parameters. The study also showed that the use of buckets to condition sorghum plants hinders the development of its root system, thus disrupting nutrient uptake. In view of these results, the combination of manure and *Faidherbia albida* litter offers an alternative to the use of expensive chemical fertilizers, which are responsible for soil degradation.

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