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Comparative Efficacy of Cashew Apple (*Anacardium occidentale* L.) Compost, NPK 15-15-15, and Chicken Manure Compost on the Growth and Yield of Maize (*Zea mays* L.) in the Sudanese Savanna Region of Northern Côte d'Ivoire

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

This study aimed to utilise organic residues from cashew (*Anacardium occidentale* L.) cultivation as a soil amendment for maize (*Zea mays* L.) cultivation in the savannas of northern Côte d'Ivoire. In the context of an agroecological transition characterised by the high availability of still-underutilised cashew by-products, the objective was to evaluate their potential to improve the fertility of poor, acidic soils and their effects on crop productivity. The experiment, conducted using a Fischer block design, compared four treatments: a control without fertilisation (T0), cashew apple compost (CPC), chicken manure compost (CFP), and NPK mineral fertiliser. The parameters measured included vegetative growth (height, collar diameter, number and size of leaves) and yield in terms of ears and grain. The results showed that chicken manure compost produced the highest yields (7.54 t/ha in ears; 5.97 t/ha in grain), followed by NPK (6.61 t/ha and 5.25 t/ha, respectively). CPC produced intermediate yields (6.06 t/ha and 4.44 t/ha), which were nevertheless higher than those of the control (4.18 t/ha and 2.96 t/ha). In conclusion, although chicken manure compost remained the most effective treatment, cashew apple compost represented a local and sustainable alternative because it promotes the utilisation of agro-industrial residues while reducing the use of chemical fertilisers. Therefore, improving it through composting is recommended to enhance its agronomic effectiveness.

Keywords: Cashew apple compost; chicken manure compost; NPK 15-15-15; maize; soil fertility; organic amendments; agro-industrial residues; nutrient management; crop yield; Sudanese savanna **.**

1. Introduction

In a global context of agroecological transition and the promotion of sustainable agriculture, the utilisation of agricultural organic waste for biological fertilisation has emerged as an essential strategy for improving soil fertility while limiting excessive reliance on chemical inputs (Singh *et al*., 2021). In this regard, the production of organic compost from various biological resources (poultry manure, cattle manure, wood shavings, and other plant and animal residues) has demonstrated its ability to enrich the soil, improve microbial biodiversity, and enhance crop productivity (Kaboré *et al*., 2010). Recent studies indicate that organic fertilisation can influence soil chemical properties and maize yield, while organic amendments may also support maize productivity through soil nutrient-cycling processes (Hu *et al*., 2023; Senou *et al*., 2025).

In Côte d'Ivoire, the cashew tree (*Anacardium occidentale* L.) plays a central role in the agricultural economy, as the country is the world's leading producer of cashew nuts. This crop, which is widespread in the central and northern regions of the country, generates considerable volumes of organic residues, notably cashew apples, which remain largely underutilised. Although rich in organic matter and conducive to beneficial biological processes, these residues are frequently left in the fields (Bamba *et al*., 2023). Yet, they constitute lignocellulosic biomass that could potentially be utilised in the production of compost for soil fertilisation (Deshmukh *et al*., 2026).

Evidence from cashew systems indicates that decayed or fermented cashew apple residues can contribute to soil nutrient replenishment, providing additional support for evaluating this biomass as an organic soil amendment (Mbasa *et al*., 2024).

In Côte d'Ivoire, poultry-dung compost has been associated with improved maize performance on sandy soil, underscoring the relevance of evaluating locally available organic materials under field conditions (Bouadou oi Bouadou *et al*., 2024).

However, large-scale compost production, whether semi-industrial or community-based, requires substantial quantities of organic matter; hence, diversifying the sources of biomass available to support this activity is important. In this regard, the cashew apple appears to be a promising resource. Although its use in composting is feasible, research on the agronomic impact of composts derived from this specific biomass remains scarce and insufficient (Frimpong Manso *et al*., 2026).

We therefore formulate the following hypotheses: (i) the application of cashew apple-based compost improves maize growth parameters; and (ii) this compost also increases maize grain and ear yields. The overall objective of this study is therefore to utilise organic residues from cashew cultivation by applying them to maize (*Zea mays* L.) crops, which are widely grown in cashew-producing areas. This approach aims not only to test the viability of cashew apple-based compost but also to promote sustainable soil fertilisation.

2. Materials and Methods

2.1 Overview of the Study Area

The subprefecture of Tafiré is located at the northern tip of Katiola, the capital of the Hambol region, in the Niakara department. It is bordered to the north by the subprefectures of Koumbala and Komborodougou, to the west and south, respectively, by those of Napié and Niakara, and to the east by the subprefecture of Kong. It covers an area of 1,900 km² within the Niakara Department (Mairie de Tafiré, n.d.). In terms of climate, Tafiré is characterised by a tropical savanna climate according to the Köppen-Geiger classification. This climate is marked by two main seasons: a rainy season lasting from May to September and a dry season lasting from October to April. The average annual temperature ranges from 26.1 to 27 °C, while average annual precipitation varies from 951.4 to 1,094 mm. The climate is further influenced by the harmattan, a hot, dry wind from the northeast that blows mainly between December and February (Mairie de Tafiré, n.d.).

Located in northeastern Côte d'Ivoire, the Tafiré subprefecture is also characterised by vegetation typical of the Sudanese savanna, dominated by tall grasses, sparse shrubs, and a few isolated trees adapted to seasonal drought. Among the most common woody species are acacias and certain perennial legumes, which contribute to nitrogen fixation in the soil and the stabilisation of the ecosystem. This vegetation, structured into herbaceous and shrubby layers, provides partial cover during the dry season and becomes greener during the rainy season (Mairie de Tafiré, n.d.). The soils of Tafiré are generally deep and well-drained, with a texture ranging from sandy to silty clay. However, they remain slightly to moderately fertile because of their relatively low organic matter content, making it necessary to apply nutrients and organic amendments to support intensive crops such as maize and cassava (Koné *et al*., 2022). The soil landscape is thus dominated by leached ferruginous soils and ferrallitic soils, whose red to reddish-brown colour reflects their high content of iron and aluminium oxides. Furthermore, the topography, which is generally flat or slightly undulating, promotes a heterogeneous distribution of moisture and nutrients: the lower slopes accumulate more mineral and organic matter, while the upper slopes, which drain more readily, are poorer in nutrients (Mairie de Tafiré, n.d.).

2.2 Equipment

2.2.1 Biological and Fertilizer Materials

The materials used consisted of biological material and fertiliser. The biological material consisted of maize seeds of the N'GOUACHIA variety, traditionally grown in the Tafiré region and, more broadly, in northern Côte d'Ivoire. This variety was selected for its high yield per hectare (five metric tons), hardiness, and nutritional value. It is a short-cycle hybrid whose vigorous plants are capable of withstanding local environmental stresses. Furthermore, its ears are well filled with yellow kernels, and its high protein content makes it suitable for both human consumption and poultry feed. Early maturity is an additional advantage, as flowering occurs approximately 55 days after sowing, allowing a rapid crop cycle suited to agricultural systems in savanna regions. It is therefore the combination of hardiness, yield, and nutritional value that makes N'GOUACHIA a variety particularly prized by local farmers.

Fertiliser application included both mineral and organic amendments. Mineral fertilisation involved the application of a ternary NPK 15-15-15 fertiliser at a rate of 200 kg/ha. In addition, organic fertilisation was implemented using chicken manure and cashew apple compost, applied at a rate of 3 t/ha. The combination of these two types of fertilisation was intended to improve nutrient availability for maize plants and enhance the sustainability of agricultural production.

2.2.2 Technical Equipment

The technical equipment used comprised three categories of tools: soil-sampling tools, tools for setting up the experimental design, and tools for measuring agromorphological parameters and maize yield. Soil sampling was conducted using an Edelman-type auger, which is suited to tropical soil conditions and is widely used in agronomic studies (Van Reeuwijk, 2002). Samples were taken from the topsoil layer at depths ranging from 0 to 40 cm, a horizon that is generally richest in organic matter and nutrients available to crops (Food and Agriculture Organization of the United Nations [FAO], 2006). The collected samples were carefully packaged in airtight plastic bags and properly labelled to ensure traceability and prevent cross-contamination. They were then transported to the laboratory for physicochemical analysis in accordance with standardised pedological protocols (Baize, 2000).

Setting up the experimental design also required several tools suitable for fieldwork. Initially, machetes were used to clear brush and open the area designated for the experiment. Ropes were then used to precisely mark and delineate the various plots within the experimental design, thereby ensuring compliance with the planned dimensions. A measuring tape was used to accurately measure the distances between reference points and ensure uniformity among the experimental plots. Finally, scales were used to determine the exact quantities of agricultural inputs (mineral and organic fertilisers) to be applied to each plot. Specific tools were used to assess agromorphological parameters and maize yield. A calliper was used to precisely measure plant collar diameter, thereby providing an indication of plant vigour and robustness. A measuring tape was used to determine plant height and leaf length and width, which are essential variables for assessing vegetative development. Finally, precision scales and weighing pans were used to quantify biomass and evaluate yield components, particularly the weights of ears and kernels.

2.3 Methods

2.3.1 Laboratory Physicochemical Analyses of Soil, Cashew Apple Compost, and Chicken Manure

Once transported to the laboratory, the soil samples and samples of the various composts underwent a series of preparatory treatments designed to ensure the quality and reproducibility of the analyses. They were first air-dried in the open, away from direct light, to prevent the degradation of sensitive compounds, and were then manually crushed to break up aggregates without altering their chemical properties. The prepared samples were subsequently sieved to 2 mm, allowing the fine fraction of the soil intended for physicochemical analyses to be isolated. Particle-size analysis was conducted using the standard Robinson pipette method, as described by Gee and Bauder (1986). This method is based on the principle of differential sedimentation of suspended mineral particles, governed by Stokes' law, and thus allows the separation and quantification of the three main particle-size fractions: sand, silt, and clay.

The organic carbon content was determined using the Walkley and Black method (Nelson & Sommers, 1982), which is based on the oxidation of organic carbon by an acidic solution of potassium dichromate, followed by titration to quantify the oxidised fraction. This method remains the standard for estimating organic carbon in tropical soils. Total nitrogen was determined using the Kjeldahl method (Bremner, 1996), which involves acid digestion of nitrogenous materials, followed by distillation and titration of the released ammonia. This approach allows the assessment of the total pool of organic and mineral nitrogen available to plants.

The exchangeable cations, namely calcium (Ca^{2+}), magnesium (Mg^{2+}), and potassium (K^{+}), were extracted using an ammonium acetate solution buffered to pH 7.0. The Ca^{2+} and Mg^{2+} cations were quantified by atomic absorption spectrometry, while potassium was measured by flame emission spectrometry. These analyses make it possible to characterise the soil's cation exchange capacity and its chemical fertility potential. Finally, soil pH was measured using an electronic pH meter based on a soil-water suspension prepared at a 1:2 mass ratio. This measurement, performed in accordance with analytical standards, serves as a fundamental indicator of the soil's chemical reactivity and nutrient availability.

2.3.2 Experimental Design and Fertilisation

The experiment was conducted using a Fischer randomised complete block design over a total area of 924 m² (44 m × 21 m). The main block was subdivided into four distinct subblocks, separated from one another by a 2-metre interval to minimise interference between treatments. Each subblock, measuring 7 m × 11 m (77 m²), was further subdivided into four elementary plots of 15 m² (3 m × 5 m), spaced 1 m apart to ensure adequate experimental isolation (Fig. 1.).

Each plot was subjected to one of the four treatments selected for the study, namely, T0, absolute control without fertilisation; CFP, chicken manure compost; CPC, cashew apple compost; and NPK, mineral fertilisation based on chemical fertiliser (NPK 15-15-15). This experimental design thus allowed a rigorous comparison of the effects of organic and mineral fertilisation on maize growth and yield while ensuring the level of replication necessary for reliable statistical analysis.

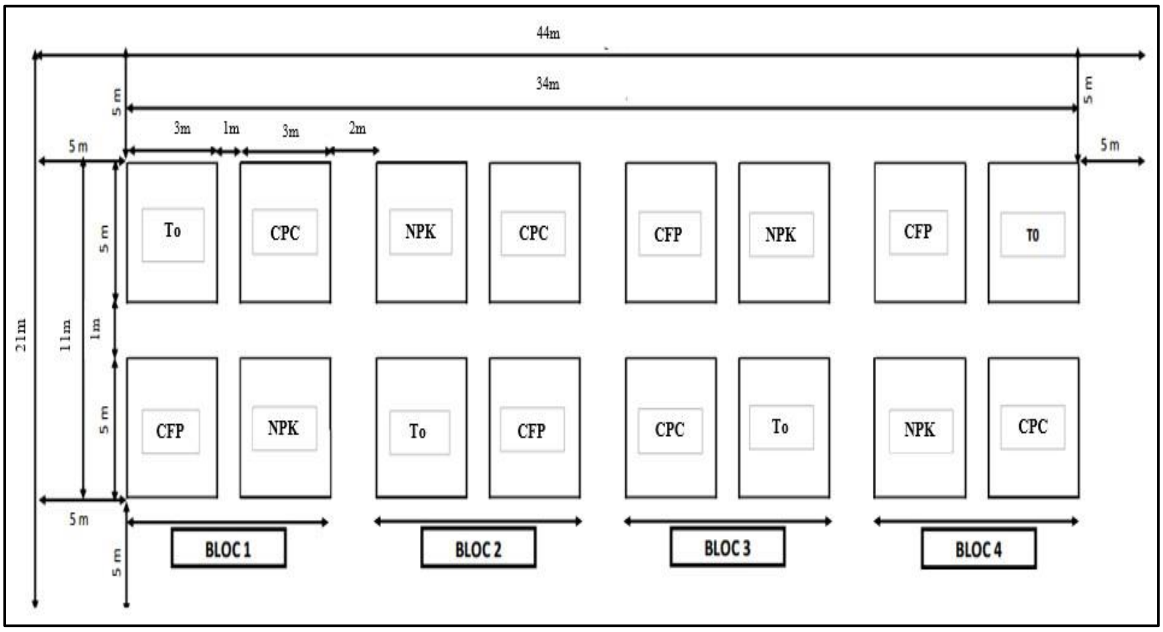

Fig. 1. Experimental design used

T0: Control (no fertilization) ; CPC: Cashew Nut Compost; CFP: Chicken Manure Compost; NPK: Compound mineral fertilizer (nitrogen-N, phosphorus-P, potassium-K)

Two types of fertilisation were tested on the maize plants: organic and mineral fertilisation. The organic inputs consisted of composts made from chicken manure and cashew apples, applied at a rate of 3 t/ha. The production of cashew apple compost first required the collection of cashew apples discarded after cashew nuts were extracted in an orchard. These were then dried to facilitate decomposition and prevent uncontrolled alcoholic fermentation. After drying, they were piled directly on the ground and lightly sprayed with water. The resulting pile was covered with a black tarpaulin and turned weekly to ensure even decomposition. The cashew apple compost reached maturity after six (6) weeks. The chicken manure compost, sourced from a poultry farm, was produced using a similar process: the manure was piled directly on the ground, lightly moistened, then covered with a tarpaulin and turned weekly for three (3) weeks. The composts produced in this manner were spread and incorporated into the soil one week before sowing, with each test plot receiving an average of 4.5 kg of compost. Mineral fertilisation was provided exclusively by the application of NPK fertiliser (15-15-15), commonly used in maize cultivation in the study area, at a rate of 0.3 kg per 15 m² plot, applied 15 days after sowing.

2.3.3 Conducting the Agronomic Trial

Sowing, completed in a single day, was carried out according to the method described by Akanvou *et al*. (2006), with a spacing of 75 cm between rows and 40 cm between planting holes. The seeds were planted at a depth of 4 to 5 cm, at a rate of three seeds per hole. After thinning, only two plants were retained per hole to ensure optimal density. Each experimental plot thus contained 100 maize plants, for a total of 1,600 plants across the entire experimental design.

2.3.4 Data Collection

Measurements were taken on 12 plants per treatment and per plot. Starting on the 10th day after sowing and continuing until flowering, growth parameters were recorded every 10 days, including plant height, collar diameter, number of leaves, and leaf length and width. The number of leaves was determined by manual counting. Plant height was measured as the distance from the ground to the topmost fully expanded leaf, while stem diameter at the base was measured using a calliper. Leaf length was measured using a tape measure from the base to the tip of the leaf, and width was recorded at the widest point, perpendicular to the midrib, also using a tape measure. These measurements made it possible to accurately track the vegetative development of maize and evaluate the influence of the various treatments on its growth.

2.3.5 Determination of Maize Grain Yield

After harvest, the maize ears were shelled by hand, and the resulting kernels were dried to reduce their moisture content to a standard level of 14%, which is generally accepted for evaluating grain yield. Drying was carried out in the open air, under cover, to avoid direct sunlight and thus preserve kernel quality. The kernels were also stirred regularly to ensure uniform drying. The residual moisture content was then measured using a moisture meter. The resulting dry weight was used to estimate grain yield per plot, which was extrapolated to a hectare using the following formula:

Yield (kg/ha) = [Dry grain weight harvested (kg) × 10,000] / Harvested area (m²)

2.3.6 Statistical Analysis of the Results

The collected data were entered using Excel 2019. After verifying the normality of the data distribution (Shapiro-Wilk test) and the homogeneity of variances (Levene's test), the means were subjected to a one-way analysis of variance (ANOVA). When a significant difference was observed between means, Fisher's LSD post hoc test at the 5% significance level was used to perform pairwise comparisons and identify homogeneous groups. All statistical analyses were performed using Statistica version 7.1 (Statsoft, Tulsa, USA).

3. Results and Discussion

3.1 Results

3.1.1 Physicochemical Characteristics of the Soil at the Study Site

Table 1 presents the physicochemical characteristics of the soil at the study site. It shows that the soil is highly acidic, with a pH of 4.81, which limits the availability of essential nutrients. The soil is also very low in organic matter, with a total carbon content of 0.65 %, a total nitrogen content of 0.06 %, and a C/N ratio below the thresholds required for good fertility. Similarly, the concentrations of available phosphorus (0.01 g.kg-1), potassium (0.10 g.kg-1), calcium (1.13 g.kg-1), and magnesium (0.62 g.kg-1) are low, as is the cation exchange capacity (13.82 cmol.kg-1). Finally, the soil texture is dominated by a high proportion of clay (74.39 %), compared with 11.89 % sand and 13.72 % silt.

Table 1. Physicochemical characteristics of the soil

Properties		Variables	Content
Chemical	Acidity	pH_{water}	4,81
	Organic content	C (%)	0,65
		N_t (%)	0,06
		C/N	10,83
	Available phosphorus	P_{ass} ($g.kg^{-1}$)	0,01
	Adsorbent complex	Na^+ ($g.kg^{-1}$)	0,21
		Mg^{2+} ($g.kg^{-1}$)	0,62
		K^+ ($g.kg^{-1}$)	0,10
		Ca^{2+} ($g.kg^{-1}$)	1,13
		CEC ($cmol.kg^{-1}$)	13,82
Physical	Particle size distribution	Clay (%)	74,39
		Sand (%)	11,89
		Silt (%)	13,72

pH : Hydrogen Ion Concentration ; C : Soil Organic Carbon ; N_t : Total Nitrogen ; C/N Ratio : Carbon-to-Total Nitrogen Ratio ; Pass : Available Phosphorus ; Na^+ : Sodium ; Mg^{2+}: Magnesium ; K^+ : Potassium; Ca : Calcium ; CEC : Cation Exchange Capacity.

3.1.2 Chemical Characteristics of Chicken Manure and Cashew Apple Composts

Table 2 presents the chemical characteristics of chicken manure and cashew apple composts. The cashew apple compost has a pH of 6.34, an organic carbon content of 4.97 %, a total nitrogen content of 0.29 %, and a C/N ratio of 17.14. It is also characterised by high levels of phosphorus (0.95 g.kg-1), potassium (7.14 g.kg-1), calcium (3.10 g.kg-1), and magnesium (0.75 g.kg-1), while its sodium content remains low (0.15 g.kg-1). Its cation exchange capacity is high (47.51 cmol.kg-1). Chicken manure compost has a pH of 6.72, an organic carbon content of 5.65 %, a total nitrogen content of 0.36 %, and a C/N ratio of 15.69. Its phosphorus (13.98 g.kg-1), potassium (35.93 g.kg-1), calcium (50.45 g.kg-1), and magnesium (7.80 g.kg-1) contents are very high, as is its sodium content (1.90 g.kg-1). Its cation exchange capacity is also very high (88.06 cmol.kg-1).

Table 2. Chemical characteristics of chicken manure and cashew apple composts

Chemical Properties	Compost	
	Cashew Apples	**Chicken droppings**
pH_{water}	6,34	6,72
Carbon (%)	4,97	5,65
N_t (%)	0,29	0,36
C/N	17,14	15.69
P_{ass} ($g.kg^{-1}$)	0,95	13,98
Ca ($g.kg^{-1}$)	3,10	50,45
Mg ($g.kg^{-1}$)	0,75	7,80
K ($g.kg^{-1}$)	7,14	35, 93
Na^+ ($g.kg^{-1}$)	0,15	1,90
CEC ($cmol.kg^{-1}$)	47,51	88,06

pH : Hydrogen Ion Concentration ; C : Soil Organic Carbon ; N_t : Total Nitrogen ; C/N Ratio : Carbon-to-Total Nitrogen Ratio ; Pass : Available Phosphorus ; Na^+ : Sodium ; Mg^{2+}: Magnesium ; K^+ : Potassium; Ca : Calcium ; CEC : Cation Exchange Capacity

3.1.3 Effects of Treatments on the Agromorphological Parameters of Maize

3.1.3.1 Effect of Treatments on the Collar Diameter and Height of Maize Plants at Maturity

Data analysis revealed a significant effect of the different treatments on the collar diameter of mature maize (Pr > F = 0.02; Table 3). The absolute control (T0), which received no fertiliser, had the smallest diameter (31.1 mm), reflecting limited growth in the absence of nutrient input. Conversely, both organic and mineral treatments significantly improved this parameter. Chicken manure compost (CFP) produced an average diameter of 66.0 mm, the highest among all treatments, indicating greater availability of nutrients that promote collar development. Cashew apple compost (CPC) also improved this parameter (43.2 mm), albeit to a lesser extent. The mineral fertiliser (NPK) resulted in a diameter of 46.1 mm, close to the overall average (46.6 mm), indicating efficacy comparable to that of CPC but lower than that of CFP.

Regarding plant height at maturity, the analysis also revealed significant variation among the applied treatments (Pr > F = 0.008; Table 3). The overall average height observed was 161.60 cm. The CFP treatment resulted in the greatest height (190.33 cm), with a statistically significant difference compared with the other treatments, as indicated by the distinct letter (b). This superiority suggests that CFP significantly improved vertical plant growth, likely because of its high content of rapidly available nutrients and its positive effect on soil structure and fertility. In contrast, the heights observed for CPC (164.3 cm), the absolute control T0 (144.6 cm), and NPK (147.16 cm) did not show notable differences among themselves (all denoted by the letter a), despite a slight improvement with CPC compared with the control. These results indicate that only the CFP treatment resulted in significantly greater growth, as the other treatments did not produce a statistically significant improvement in plant height compared with the control.

Table 3. Effects of treatments on the development of collar diameter and plant height in maize at maturity

Treatments	Collar diameter of plants (mm)	Plant height (cm)
T0	31,1a	144,6a
CPC	43,2ab	164,3a
CFP	66,0b	190,33b
NPK	46,1ab	147,16a
P>F	0,02	0,008

T0 : Absolute control ; CPC: Cashew Nut Compost ; CFP : Chicken Manure Compost ; NPK : Compound mineral fertilizer (nitrogen-N, phosphorus-P, potassium-K) ; P: probability ; F : calculated value. Values denoted by the same letters are not significantly different ; those denoted by different letters are statistically different at the 5% significance level, according to the Newman-Keuls test.

3.1.3.2 Effect of Treatments on the Number, Length, and Width of Mature Corn Leaves

Analysis of the influence of different fertiliser treatments on the leaf characteristics of maize at maturity revealed significant differences among treatments in both the number and dimensions of leaves (Table 4). The associated probabilities (P > F) for the number of leaves, length, and width were 0.007, 0.04, and 0.02, respectively, indicating statistical significance at the 5% level. The absolute control (T0), which was unfertilised, had the lowest values, with an average of 8.63 leaves per plant, a length of 43.42 cm, and a width of 3.52 cm, all below the overall averages observed (11.70 leaves; 57.93 cm in length; 3.96 cm in width). The application of cashew apple compost (CPC) resulted in a moderate improvement in these parameters (10.88 leaves; 56.73 cm in length; 3.81 cm in width), reflecting a positive fertilising effect, although the values remained below the overall averages. Mineral fertiliser (NPK) improved all the parameters studied, with values above the averages (11.03 leaves; 59.28 cm in length; 4.05 cm in width), demonstrating the notable effectiveness of the chemical fertiliser. Chicken manure compost (CFP), however, stood out for its superior performance, with 16.59 leaves, 72.34 cm in length, and 4.49 cm in width, indicating a strongly favourable effect on leaf development. These results demonstrate the differing effectiveness of organic and mineral inputs on maize leaf parameters, with a clear advantage in favour of CFP.

Table 4. Effect of treatments on the number, length, and width of maize leaves at maturity

Treatments	MNF	LMF (cm)	LarMF (cm)
T0	8,63a	43,42a	3,52a
CPC	10,88a	56,73ab	3,81a
CFP	16,59b	72,34b	4,49b
NPK	11,03a	59,28ab	4,05ab
P>F	0,007	0,04	0,02

T0: Absolute control; CPC: Cashew Nut Compost; CFP: Chicken Manure Compost; NPK: Compound mineral fertilizer (nitrogen-N, phosphorus-P, potassium-K); NMF: Mean number of leaves; LMF: Mean leaf length; LarMF: Mean leaf width. P: probability and F: calculated value. Values denoted by the same letters are not significantly different; those denoted by different letters are statistically different at the 5% significance level, according to the Newman-Keuls test.

3.1.3.3 Effect of Treatments on Ear and Grain Yields of Maize

Analysis of the results revealed that the application of the various fertiliser treatments had a marked effect on ear and grain yields (Table 5). The chicken manure compost (CFP) treatment produced the highest yields, at 7.54 t/ha for ears and 5.97 t/ha for grain. These results reflect the agronomic effectiveness of this compost, likely because of its high content of essential nutrients (nitrogen, phosphorus, and potassium) and its beneficial effects on the soil's physicochemical properties. The mineral fertiliser (NPK) also produced substantial yields (6.61 t/ha for ears; 5.25 t/ha for kernels), confirming the immediate effectiveness of this type of fertilisation. However, the yields obtained with CFP remained higher, suggesting greater potential for this organic amendment to support agricultural productivity.

Cashew apple compost (CPC) produced intermediate yields (6.06 t/ha for ears; 4.44 t/ha for kernels). Although these values were lower than those observed with CFP and NPK, they nevertheless reflected a positive effect of this amendment compared with no fertilisation. The absolute control (T0), which received no fertiliser, recorded the lowest yields (4.18 t/ha for ears; 2.96 t/ha for kernels). These results highlight the importance of fertilisation for improving crop performance, particularly in low-input systems. The overall average (MG), calculated across all treatments, was 6.10 t/ha for ears and 4.65 t/ha for kernels, providing a basis for assessing the relative performance of each treatment within the experimental design. Thus, the CFP and NPK treatments were above this average, while the CPC treatment was close to it and the control (T0) remained well below it. Overall, all fertiliser treatments increased yields compared with the control. Chicken manure compost appeared to be the most effective treatment among those tested, combining high productivity with the utilisation of local organic resources. These results reinforce the value of promoting organic amendments in sustainable fertilisation strategies.

Table 5. Effect of treatments on corn ear and grain yield

Treatments	Ear yield (t/ha)	Grain yield (t/ha)
T0	4,18c	2,96c
CPC	6,06a	4,44a
CFP	7,54b	5,97b
NPK	6,61ab	5,25ab
P>F	0,0004	0,0002

T0: Control; CPC: Cashew Nut Compost; CFP: Chicken Manure Compost; NPK: Compound mineral fertilizer (nitrogen-N, phosphorus-P, potassium-K). P: probability and F: calculated value. Values denoted by the same letters are essentially identical; those denoted by different letters are statistically different at the 5% significance level, according to the Newman-Keuls test.

3.2 Discussion

Sustainable improvement of tropical soil fertility remains a major priority for intensifying agricultural production without compromising natural resources. In this context, organic soil amendments represent a strategic alternative to mineral fertilisers, which are often costly and difficult to access. The present study therefore aimed to evaluate the comparative effects of chicken manure compost (CFP), cashew apple compost (CPC), and NPK fertiliser on soil characteristics, vegetative growth, and maize yield. The results obtained enable the properties of the amendments used to be related to the observed agromorphological responses while also indicating prospects for the utilisation of agro-industrial residues.

Soil analysis of the experimental site revealed a severe fertility constraint, characterised by a very clayey texture (74.39 %), pronounced acidity (pH 4.81), low organic matter content (0.65 % total carbon), and a widespread deficiency in major nutrients (nitrogen, phosphorus, potassium). These characteristics confirm the soil's low natural fertility, typical of tropical ferrallitic soils, and therefore justify the application of organic amendments to restore productivity (FAO, 2016; Sanchez, 2002).

Chicken manure compost stood out for its high nutrient content (N : 0.36 % ; P : 13.98 g.kg-1 ; K : 35.93 g.kg-1 ; Ca : 50.45 g.kg-1) as well as its high cation exchange capacity (88.06 cmol.kg-1), ensuring good nutrient retention and a gradual release of nutrients.

These characteristics therefore helped optimise mineral nutrition for maize and support sustained vegetative growth (Azeez & Van Averbeke, 2010; Palm *et al*., 2001). Cashew apple compost, while less nutrient-rich, nevertheless has a moderately acidic pH (6.34) and a significant cation exchange capacity (CEC) (47.51 cmol.kg-1), allowing a notable improvement in soil properties. Its balanced chemical composition therefore makes it an attractive soil amendment in low-input farming systems.

Chicken manure compost (CFP) showed the best agronomic performance on maize, both in terms of vegetative growth (collar diameter (66.0 mm), plant height (190.33 cm), number of leaves (6.59), leaf length (72.34 cm), and leaf width (4.49 cm)) and ear yield (7.54 t/ha) and grain yield (5.97 t/ha). These results were followed, in descending order, by those of NPK and then cashew apple compost, which remained intermediate. These observations corroborate those of several authors who have highlighted the effectiveness of nitrogen-rich organic amendments such as chicken manure (Adeli *et al*., 2007), the intermediate performance of plant-based composts such as cashew apple compost (Frimpong Manso *et al*., 2026), and the rapid but short-lived effect of NPK, particularly when used without an associated organic input (Vanlauwe *et al*., 2002).

Cashew apple compost (CPC) represents an attractive alternative within a sustainable agriculture approach, particularly in cashew-producing areas. Derived from processing residues that are often underutilised, it is an inexpensive local input. Its composition, characterised by a pH close to neutral, low salinity, and a moderate C/N ratio, makes it a suitable soil amendment for fertilising acidic tropical soils. Although its effects on yields remained lower than those of CFP, the results obtained confirm that it can nonetheless improve soil fertility, stimulate maize growth, and reduce dependence on chemical fertilisers. Its use would also allow the recovery of agro-industrial waste, thereby contributing to the integrated management of local resources and the reduction of environmental impacts associated with the disposal of organic residues. However, further studies are needed to optimise its formulation: composting with nitrogen-rich materials, such as poultry manure or legume residues, could increase its nutrient content and enhance its agronomic effects, as suggested by Kaboré *et al*. (2010). Furthermore, improving its maturation process and conducting trials on other crops would help expand its scope of application to various production systems.

4. Conclusion

The results of this study confirm that the use of organic amendments, particularly chicken manure compost (CFP), is an effective strategy for improving the physicochemical properties of degraded tropical soils and the vegetative and productive performance of maize. Owing to its high content of major nutrients (nitrogen, phosphorus, potassium, calcium), CFP resulted in superior growth and significantly improved yields compared with the unfertilised control and even with NPK mineral fertiliser. This result highlights the ability of this compost to correct soil nutrient deficiencies, stimulate crop growth, and improve agricultural productivity under low-input conditions. Furthermore, although it has lower nutrient levels than CFP, cashew apple compost (CPC) demonstrated a significant agronomic effect: its application led to notable improvements in several growth and yield parameters, with performance superior to that of the absolute control. Its balanced composition (pH close to neutral, appreciable cation exchange capacity, low salinity) further enhances its potential as a locally available soil amendment, particularly in cashew-producing areas. Thus, in line with agroecological farming practices and the valorisation of organic residues, CPC appears to be a promising option for resource-constrained farms. These findings indicate that organic soil amendments, particularly those derived from agro-industrial residues such as cashew apples, can contribute to addressing fertility, productivity, and sustainability challenges in tropical agricultural systems.

5. Limitations

This study was conducted as a single field trial at Tafiré using one maize variety and fixed fertiliser application rates, which limits generalisability to other soils, environments, varieties, and management conditions. Growth measurements were based on 12 plants per treatment per plot, and the manuscript does not specify how these plants were selected, introducing potential sampling bias. Manual measurements using tapes and callipers may also introduce measurement variability. Residual spatial soil heterogeneity and uncontrolled field conditions could have influenced treatment responses. Future multi-season, multi-site trials with larger, explicitly randomised samples and additional application rates are recommended.

Declaration of AI Use

This manuscript was prepared through the intellectual contributions of the author(s) to the study design, data analysis, interpretation of results, and scholarly content. Grammarly and ChatGPT were used solely to assist with grammatical refinement and reference formatting during manuscript revision. The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

Competing Interests

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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