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Effect of Compost Based Local Substrates on Soil Fertility and Agronomic Performance of Cowpea (*Vigna unguiculata* (L.) Walp) in Burkina Faso Semi-Arid Zone.

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Abstract

Declining soil fertility remains a major constraint for farmers in the semi-arid Sahelian regions. This study assessed the effects of increasing rates of compost combined with zaï pits on the productivity of the cowpea variety "*Komecallé*" (*Vigna unguiculata* (L.) Walp) and on soil fertility. Soil samples and agronomic parameters were collected using a completely randomized block design with four treatments replicated four times in Pabré, Burkina Faso: T0 = Zaï only; T1 = Zaï + 1 t ha^{-1} of compost; T2 = Zaï + 2 t ha^{-1}; and T3 = Zaï + 3 t ha^{-1}. Analysis of variance (ANOVA) and Tukey's HSD test at the 5% significance level were applied. Results revealed that mineral nitrogen increased by 18,9%, 23,9%, and 22,1%; available phosphorus by 21,3%, 44,7%, and 23,6%; and available potassium by 21,7%, 18,2%, and 22,6% under T3, T2, and T1 respectively. Haulm yields increased significantly by 65% under T3, while grain yields increased by 82% under T2. The treatment T2 (2 t ha^{-1} compost) proved to be the most effective option for enhancing both productivity and soil fertility. The valorization of local substrates could contribute in soil fertility and cowpea production policies in semi-arid regions and reduce fertilizers cost for farmers.

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Introduction

The use of organic fertilizers is an environmentally friendly approach that can enhance soil fertility and conservation, while improving cereal yield and quality.[1] Although chemical fertilizers provide rapid nutrient availability and often higher immediate yields, they tend to degrade soil fertility and increase vulnerability to erosion.[2] Conversely, organic fertilizers enrich the soil with nutrients, restore its structure over time, and are comparatively safer for the environment.[3] They supply balanced nutrition to crops, stimulate soil microbial diversity, and enhance nutrient availability, plant growth, and yield.[4] Long-term evidence shows that organic fertilizers improve and maintain soil quality and the productivity of major crops.[5]

Legumes, which require high phosphorus inputs for optimal nodule development and growth,[6] can particularly benefit from organic amendments in acidic or aluminum-rich soils. Organic amendments are a sustainable option for cowpea production in arid and semi-arid regions because they increase soil organic matter and thus productivity.[7] In Burkina Faso, climate change has driven the adoption of climate-smart agricultural practices to strengthen resilience to climatic shocks and soil degradation8. One such adaptation involves the use of traditional water-harvesting practices such as the 'zaï' technique, which consists of digging small basins approximately 30 cm in diameter and 15–20 cm deep to collect runoff and organic matter[9,10,11,12] Previous studies have shown the beneficial effects of compost applied within zaï pits on the agronomic performance of cowpea and soil nitrogen.[13,14,15] Although cereals (millet, sorghum, maize, rice, fonio) remain the main crops in Burkina Faso,[16] cowpea covers about 1.7 million ha, producing more than 829,000 tonnes in 2022.[17] Cowpea is a vital crop during the hunger season18 providing a high protein content (23.4%), low fat (1.8%), and carbohydrates (60.3%).[19] Besides its nutritional and economic importance, cowpea fixes atmospheric nitrogen and can be used in intercropping[20] or rotation systems,[21,22] improving soil fertility. Among alternative fertilization approaches for sustainable production, fertilization practices based on the use of organic amendments can be a technique for improving vegetable crop productivity,[23] The practice of zaï goes hand in hand with the use of organic fertilizer. However, few studies in Burkina Faso have examined the use of locally produced biofertilizers made from native substrates within zaï pits for improving soil fertility and cowpea yield. This study therefore evaluated the effect of composts produced from *Loudetia togoensis*, *Andropogon pseudapricus*, and *Andropogon gayanus straw*, cow dung, and ash wood on soil fertility and the agronomic performance of cowpea (*Vigna unguiculata* (L.) Walp) under semi-arid conditions.

Material and methods

Experimental Site

The experiment was conducted in the village of Sag Nyônyôgo (12°52' S; -1°52' W) in the district of Pabré, located in the Central Region of Burkina Faso. Tropical Sudano-Sahelian climate marked by two mains seasons characterized the study site: a rainy season from June to September and a dry season from October to May. The main woody plants are *Vitellaria pardoxa*, *Parkia biglobosa*, *Adansonia digitata*, and *Lannea microcarpa*. The most common herbaceous plants are *Andropogon gayanus*, *Andropogon pseudapricus*, and *Senna obtusifolia*.

According to the Central Regional Meteorological Directorate, the highest rainfall was 1,022.5 mm in 2021 with 55 days of rain, and the lowest was 517.5 mm in 2017 with 32 days of rain. Water levels and the number of rainy days in 2023 varied from 335 mm in 10 days of rain in August to 12 mm in May with one day of rain.

The zone of experimental site is characterized by a low plateau with an altitude of between 300 and 400 m. The soils are mainly tropical ferruginous, lateritic and clayey, and based on a large cracked granite. These soils are poor, fragile and therefore vulnerable to erosion. In fact, the soils are subject to continuous degradation due to water and wind erosion. They only offer good yields in lowlands or after sufficient amendment.

Fertilizer and Plant Material

Compost produced by women from the NABONSWENDE association in Niessega, part of the NGO (Non-Governmental organization) Association for Research and Training in Agroecology (ARFA), was used (Table 1). It was produced from substrates composed of bush grass straw (60% *Loudetia togoensis*, 30% *Andropogon pseudapricus*, and 10% *Andropogon gayanus*); cow manure; and ash. Composting lasted 45 days.

The "*Komcallé*" variety of cowpea, characterized by an erect growth habit with a 60-days cycle, tolerance to drought and Striga, and good vigor at emergence were used. This variety, developed by the Institute for the Environment and Agricultural Research of Burkina Faso (INERA), has a potential grain yield of 1,800 kg ha^{-1} and an average grain yield in farming conditions of 750 kg ha^{-1}.

Table 1: Organic and chemical composition of the compost

Parameters	Units	Values
OM	%	47,28
C	%	27,42
N	%	1,42
$N\text{-}NH_4$	mg kg^{-1}	139,60
$N\text{-}NO_3$	mg kg^{-1}	46,48
Mineral N (N-NH4+ N-NO3)	mg kg^{-1}	186,08
C/N		19
P	%	1,29
P ass	g kg^{-1}	12,13
K	%	1,45
K dispo	mg kg^{-1}	679

C = total carbon; OM = total organic matter; N = total nitrogen; N-NO3 = nitrous nitrogen; N-HN4 = ammoniacal nitrogen; mineral N = mineral nitrogen; C/N = total carbon/total nitrogen ratio; P = total phosphorus; K = total potassium; P ass = available phosphorus; K disp = available potassium.

Experimental Design and Crop Management

It consisted of four completely randomized Ficher blocks (21 m x 21 m) comprising three factorial treatments per block, with a total of 16 elementary plots (4 m x 4 m = 16 m²). One-meter aisles separated the blocks and the elementary plots within the same block. Each elementary plot consisted of six rows of ten zaï holes, for a total of 60 pits. The spacing was 80 cm between rows and 40 cm between zaï holes in the same row. According to scientific research recommendations, the minimum doses of organic fertilizers such as compost or manure are approximately 3 tons per hectare every two years. The objective of the study was to assess whether doses below this recommended minimum could produce similar effects, in order to promote a more rational use of organic fertilizers. The treatments applied were.

- T0 = absolute control with no input;
- T1 = 1 t ha^{-1} of compost;
- T2 = 2 t ha^{-1} of compost;
- T3 = 3 t ha^{-1} of compost.

The experimental setup consisted first of manual land clearing and delimitation of the location of the setup and the elementary plots. Next, the zaï holes were dug manually following a cross-pattern of 40 cm between the lines perpendicular to the slope and 40 cm on the lines. The zaï holes were 20 cm in diameter and 15 cm deep. In total, there were 960 holes for the entire experimental setup. The quantities of compost added per zaï hole were 30 g per hole for T1; 54 g per hole for T2; and 80 g per hole for T3. The compost was added in a single application as a base fertilizer per hole and covered with a thin layer of soil with two cowpea plants per hole. Weeding was carried out on the 15th and 25th day after sowing (DAS) and manual weeding was carried out according to the weed coverage rate.

Data Collection

Morphological and physiological parameters were collected during the vegetative phase of the cowpea plants, as well as on biomass and nodule production at harvest.

Morphological and physiological parameters were assessed every two weeks on five plants selected along the diagonal of each elementary plot. These parameters included seed emergence rate (SER) at 7 days after sowing, number of leaves (NL) and ramifications (NR), plant height (PH), and diameter (PD). The HPL and DPL of the plants were measured every two weeks on five plants selected from the diagonals of each elementary plot. PH was measured using a graduated ruler from the base of the collar to the highest leaf. PD was measured using a caliper.

The number of days from sowing to the flowering date of the first plant (FLO) and the number of days from sowing to the flowering of 50% of the plants (FLO50) were determined. The nodules and plants biomass were harvested on the 45th day after sowing. This involved digging up five plants when 50% of the plants had flowered on each elementary plot. The root parts were soaked in water, carefully cleaned, and rinsed thoroughly to remove soil from the roots using a 2 mm mesh sieve. The nodules were detached from the roots, counted, and stored in A4 paper to be dried in the laboratory and then weighed. The nodules number (NN) was evaluated. The nodules dry weight (NDW) in mg was determined using a METTLER AE200 balance. The fresh biomass at flowering (above-ground and root biomass) was wrapped in aluminum foil and dried in an oven at 40°C until a constant weight was obtained, then weighed again to obtain the total biomass (root and aerial) dry weight (BDW) at flowering in g. BDW was measured using a METTLER PJ4000-F digital scale.

The mature pods were harvested and dried as they ripened until the end of the growing cycle. The number of pods (NP) was obtained by counting the pods per treatment. The number of plants at harvest (NPH) was determined by counting the cowpea plants per treatment. The of haulm yields (HY) and grains yields (GY) at harvest in t ha^{-1} were determined respectively by weighing the haulm at harvest and the grains per treatment and then reported per ha. The weights of 100 grains (W100G) in g were determined by counting 100 grains followed by weighing them according to the treatments.

Soil Sampling and Analysis

Three (3) elementary samples were taken diagonally across each elementary plot in zaï holes at harvest time. A composite sample was created for each elementary plot and layer by combining these three elementaries samples in the 10-20 cm layer. Composite samples were taken for each treatment. The composites for each treatment were created by combining 200 g of soil. A total of twelve (12) composite soil samples (4 blocks x 3 treatments) were created. These composite samples were then dried in the open air for one day and sieved to 2 mm. Aliquots of the fine soil fraction collected after sieving were used for laboratory analysis.

Soil parameters analysis consisted of determining the levels of organic matter and carbon; total N, P, and K; mineral nitrogen, available phosphorus, and available potassium at the CID-Ingénierie laboratory in Ouagadougou. The methods used to determine these soil parameters were.

- organic carbon using the Walkley-Black method.[24] The organic matter content was obtained by multiplying the carbon content value by a coefficient of 1.724;
- total nitrogen (N) and mineral nitrogen (NH4 and NO3) by colorimetry after digestion using the Kjeldahl method,[25]
- total phosphorus (P), determined using the Kitson and Mellon method,[26] and available phosphorus (P ass) using the Bray and Kurtz method,[27]
- total potassium (K), according to the Ahenkorah method[28] using 6N HCl. Available potassium (K disp), extracted using a mixed solution of 0.1 N HCl and H2CEO4, measured using a flame photometer after mineralization.

Statistical Analysis of Data

The Shapiro-Wilk test was used to test the normality of the agronomic data collected. Graphs were designed to evaluate the evolution of the morphological parameters of cowpea under different treatments over time. An analysis of variance (ANOVA) and Tukey HSD mean separation test were performed at a 5% significance level for robustness. XLSTAT4.1, 2023 by Addinsoft[29] was used for this analysis.

Results and Discussion

Effect of Treatments on Soil Fertility

Table 2 presents results of soil analysis at the cowpea harvest. The values of the chemical parameters of the soil varied in organic matter (OM) from 0.86% under treatment T0 to 1.27% under treatment T2.

Soil organic matter without compost input has a low level of fertility[30] There was a 32%, 31%, and 21% increase of OM under T2, T3, and T1, respectively, compared to T0. The increase in organic matter content recorded under treatments T2, T3, and T1, respectively, compared to T0 can be explained by the additional organic matter inputs from compost decomposition, which improved the chemical fertility of the soils. These results confirm the essential role of organic matter in the chemical fertility of tropical soils, which translates into improved properties and better nutrient availability.[14,31]

Soil carbon content fluctuated from 0.45% under T0 to 0.74% under T2. Increases of 39% and 36%; and 29% in carbon were obtained under T2, T3, and T1, respectively, compared to T0.

Total nitrogen (N) content in the soil varied from 0.04% under T0 to 0.07% under T3 and T2, respectively. Increases of 43%; 43%; 33% were obtained under treatments T3, T2, and T1, respectively, compared to T0. Total nitrogen content in the soil varied in proportion to the amount of compost applied. Different doses of cattle manure contributed positively to the increase in all soil chemical characteristics, including nitrogen, probably due to the increase in soil organic matter.[32] Cowpea improves the organic and nitrogen status of the soil by 11% and 5% respectively compared to fallow land.[21,22]

Mineral nitrogen (mineral N) content fluctuated from 31.84 ppm in T0 to 41.85 ppm in T2. Mineral N was improved by 24%; 22%; 19% under T2; T1; T3 respectively compared to T0. The C/N ratio went from 12 under T0 to 10 under T1; T2; T3 respectively. C/N was reduced by 20% under T1; T2; T3 respectively compared to the value obtained under T0.

Total phosphorus (P) levels ranged from 96.93 ppm under T0 to 221.50 ppm under T2. P levels improved by 56%, 53%, and 41% under T2, T3, and T1, respectively, compared to T0. Soil phosphorus content increases after amending the zaï with compost in sorghum mono-cropping.[14]

Assimilable phosphorus (P ass) levels ranged from 4.47 ppm under T0 to 8.09 ppm under T2. P ass improved by 45%, 24%, and 21% under T2, T1, and T3, respectively, compared to the value obtained under T0.

Total potassium (K) levels ranged from 414.10 ppm under T0 to 755.80 ppm under T3. K levels improved by 45%, 39%, and 38% under T3, T2, and T1, respectively, compared to the value obtained under T0. Compost inputs have a significant effect on soil potassium content.[31]

The available potassium (K disp) content of the soils changed from 90.02 ppm under T0 to 116.27 ppm under T1. K disp improved by 23%, 22%, and 18% under T1, T3, and T2, respectively, compared to the value obtained under T0. Overall, the application of 2 t ha^{-1} of compost (T2) was most effective in terms of improving soil fertility in cowpea mono-cropping.

Table 2 : Effect of treatments on soil fertility

Treat-ments	OM %	C %	N %	C/N	P ppm	K ppm	N-NO3 ppm	N-HN4 ppm	minéral N ppm	P ass ppm	K disp ppm
T3	1.24	0,72	0.07	10	204.50	755.80	10.90	28.40	39.26	5.68	115.01
T2	1.27	0.74	0.07	10	221.10	683.30	10.80	31.07	41.85	8.09	110.02
T1	1.09	0.63	0.06	10	163.60	662.60	10.40	30.50	40.88	5.85	116.27
T0	0.86	0.45	0.04	12	96.93	414.10	5.91	25.93	31.84	4.47	90.02

T0 = control without any input; T1 = 1 t ha^{-1} of compost; T2 = 2 t ha^{-1} of compost; T3 = 3 t ha^{-1} of compost; C = total carbon; OM = total organic matter; N = total nitrogen; C/N = total carbon/total nitrogen ratio; N-NO3 = nitrous nitrogen; N-HN4 = ammoniacal nitrogen; mineral N = mineral nitrogen ((N-NH4+ N-NO3); P = total phosphorus; K = total potassium; P ass = available phosphorus; K disp = available potassium

Effect on Morphological and Physiological Parameters of Cowpea

Table 3 shows the effects of treatments on the mean morphological and physiological parameters values of cowpea plants. The emergence rates of cowpea plants (SER) varied between 81% and 98% under T0 and T2, respectively. No significant difference (P = 0.110) between the SER obtained under the different treatments T0, T1, T2, and T3.

The number of days from sowing to the flowering date of the first plant (FLO) ranged from 42 ± 1.17 days under T3 to 49 ± 1.17 days under T0. Treatments T3 and T2 significantly (P = 0.006) reduced FLO by 7 and 6 days, respectively, compared to T0.

The number of days from sowing to flowering in 50% of plants varied (FLO 50) from 50 ± 1.17 days under T0 to 49 ± 1.17 days under T3 and 49 ± 1.35 days under T1. The analysis of variance did not reveal any significant difference at the 5% threshold (P = 0.197) between treatments T0, T1, T2, and T3.

Plant heights (PH) fluctuated between 21.30 ± 0.77 cm under T0 and 26.60 ± 0.77 cm under T1. The compost-based treatments (T1, T2, and T3) significantly improved PH (P ≤ 0.001) compared to the control treatment T0. Significant increases of 20%, 15%, and 17% were obtained under treatments T1, T2, and T3, respectively, compared to the absolute control T0.

The diameters at the base of the plant collar (PD) varied between 5.37 ± 3.06 cm under T0 and 7.48 ± 2.98 under T1. PD were significantly (P < 0.0001) improved by 28%, 24%, and 18% under T1, T2, and T3, respectively, compared to the value obtained under T0.

The average number of leaves per plant (NL) ranged from 14 ± 3.06 under T0 to 26 ± 3.06 under treatment T3. Treatments T3, T2, and T1 significantly (P = 0.006) increased NL by 46% compared to T0.

The average number of ramifications per plant (NR) fluctuated from 1 ± 0.27 under T0 to 4 ± 0.28 under T3. NR significantly (P < 0.0001) increased by 75% under treatments T1, T2, and T3, respectively, compared to T0.

The highest morphological performance, namely plant height and diameter growth, number of leaves and ramifications of cowpea plants, was observed in the zaï holes associated to the compared to the zaï without any input (T0). This demonstrates the beneficial effects of applying compost to zaï holes on the agronomic performance of cowpea. Similar results are found by others authors.[14,15] Additional compost inputs improved nutrient availability and promoted plant growth. Phosphorus availability is one of the most important determinants of legume growth.[3]

Table 3 : Effect of treatments on morphological and physiological parameters of cowpea

Traetments	SER %	FLO days	FLO50 days	PH cm	PD cm	NL	NR
T3	97±5a	42±1.17a	49±1.17a	25,90±0.79b	6.55±2.98b	26±3.06b	4±0.28b
T2	98±5a	43±1.17a	50±1.17a	24,95±0.77b	7.07±2.98b	26±2.98b	4±0.27b
T1	81±5a	44±1.35ab	49±1.35a	26.60±0.77b	7.48±2.98b	26±2.98b	4±0.27b
T0	98±5a	49±1.17b	54±1.17a	21.30±0.77a	5.37±3.06a	14±3.06a	1±0.27a
P	0.110	0.006	0.197	< 0.0001	< 0.0001	0.006	< 0.0001

T0 = control without any input; T1 = 1 t ha^{-1} of compost; T2 = 2 t ha^{-1} of compost; T3 = 3 t ha^{-1} of compost; SER = seed emergence rate; FLO = number of days from sowing to the flowering date of the first plant; FLO50 = number of days from sowing to the flowering of 50% of plants; PH = plant height; DPL = plant diameter; NL = number of leaves; NR = number of ramifications; The numbers are the means ± standard errors of the parameters evaluated. P = probability according to ANOVA at a significance level of 5%. The means ± standard errors in the same column with the same letter do not differ significantly according to the Tukey HSD test at a significance level of 5%. P < 0.05: significant (S); P ≤ 0.01: very significant (VS); P ≤ 0.001 (HS): highly significant; P ≥ 0.05: not significant (NS)

Effect of Treatments on Nodulation and Biomass of Cowpea at Flowering

The effects of treatments on nodulation and biomass production of cowpea at 45 days after sowing are shown in Table 4. The nodules number (NN) in cowpea varied from 5 ± 2.63 under treatment T0 to 19 ± 2.70 under treatment T3. The NN were significantly (P=0.005) improved by 74%, 62%, and 50% under T3, T2, and T1, respectively, compared to the value obtained under T0. The nodules dry weight (NDW) ranged from 26.39 ± 27.77 mg under treatment T0 to 135.10 ± 28.49 mg under treatment T3. The NDW increased significantly (P = 0.04) by 80%; 69%; 58% under treatments T3; T2, and T1 treatments, respectively, compared to the value obtained under T0. biomass dry weight (BDW) ranged from 7.06 ± 1.61 g under treatment T0 to 20.53 ± 1.66 g under treatment T3. BDW increased significantly (P ≤ 0.001) by 66%; 60%; 57% under T3; T2; T1, respectively, compared to the value obtained under T0.

The increase in the number and weight of nodules could be explained by the fact that adding organic fertilizers to the soil increases organic matter, nitrogen, and total phosphorus, thereby affecting the soil microbial community.[33] This microbial population increases considerably, leading to an increase in the number of nodules. The addition of organic substrates improves nodule production (number and weight) and cowpea biomass at flowering.[34] At high doses, it has a depressive effect on nodulation, but at low doses, it acts as a "starter" by promoting the initiation of nodule formation. Nodulation depends on the nitrogen content of organic matter, so when the minimum nitrogen content is reached, the nodulation process begins.[13] In this study, the nitrogen in the compost acted as a "starter," promoting the growth of nodule weight and number.The number of nodules increases with increasing phosphorus doses.[6,35]

Table 4: Effect of treatments on nodulation and biomass production of cowpea at flowering

Treatments	NN	NDW (mg)	BDW (g)
T3	19±2.70b	135.10±28.49b	20.53±1.66b
T2	15±2.63b	83.8 ±27.77ab	17.69±1.61b
T1	10 ±2.63ab	62.44±27.77ab	16.48±1.61b
T0	5±2.63a	26.39±27.77a	7.06±1.61a
P	0.005	0.04	< 0.0001

T0 = control without any input; T1 = 1 t ha^{-1} of compost; T2 = 2 t ha^{-1} of compost ; T3 = 3 t ha^{-1} of compost ; NN = nodules number; NDW = nodule dry weight; BDW = biomass dry weight. The numbers are the means ± standard errors of the parameters evaluated. P = probability according to ANOVA at a significance level of 5%. The means ± standard errors in the same column with the same letter do not differ significantly at the 5% threshold. P < 0.05: significant (S); P ≤ 0.01: very significant (VS) ; P ≤ 0.001 (HS) : highly significant.

Effect of Treatments on Cowpea Yield Parameters and Yield at Harvest

Table 5 shows the effects of treatments on cowpea yield parameters at harvest. The number of cowpea plants at harvest (NPH) ranged from 75 ± 6.16 under treatment T1 to 98 ± 7.11 under treatment T2. ANOVA at the 5% threshold shows that there is no significant difference (P = 0.171) between treatments in terms of NPH. The number of cowpea pods (NP) ranged from 106 ± 29.64 under control treatment T0 to 350 ± 34.23 under treatment T2. NP increased significantly (P = 0.000) by 70%, 69%, and 15% under treatments T2, T1, and T3, respectively, compared to the value obtained under T0.

The haulm yields (HY) ranged from 0.80 ± 0.15 t ha^{-1} under T0 to 2.31 ± 0.15 t ha^{-1} under T3. The HY were significantly (P = 0.000) increased by 65%; 52%; 40% under treatments T3, T2, and T1, respectively, compared to the value obtained under T0. The average grain yields (GY) of cowpea fluctuated from 0.29 ± 0.14 t ha^{-1} under T0 to 1.59 ± 0.16 t ha^{-1} under T2. GY were significantly (P < 0.0001) improved by 82%; 81%; 42% under treatments T2; T1; T3, respectively, compared to T0. The weight of 100 grains (W100G) ranged from 16.25 ± 1.73 g under T0 to 20.17 ± 2.00 g under T2. P100 Gr was not significantly different (P = 0.448) under treatments T0, T1, T2, and T3.

The application of 3 t ha^{-1} (T3) of compost was more effective for cowpea nodulation and biomass production at flowering than the other treatments. This could be explained by the availability of nutrients generated by the high dose of compost, which provided balanced nutrition by enriching the microbial diversity of the soil and thus facilitating the availability of nutrients for plants, plant growth, and plant yield.[4]

Table 5: Effect of treatments on cowpea yield parameters at harvest

Treatments	NPH	NP	HY t ha^{-1}	GY t ha^{-1}	W100G g
T3	87±6.16a	125±29.64a	2.31±0.15c	0.50±0.16a	18.28±1.73a
T2	98±7.11a	350±34.23b	1.67±0.15bc	1.59±0.16b	20.17±2.00a
T1	75±6.16a	332±29.64b	1.34±0.15ab	1.56±0.14b	19.70±1.73a
T0	87±6.16a	106±29.64a	0.80±0.15a	0.29±0.14a	16.25±1.73a
P	0.171	0.000	0.000	< 0.0001	0.448

T0 = control without any input; T1 = 1 t ha^{-1} of compost; T2 = 2 t ha^{-1} of compost; T3 = 3 t ha^{-1} of compost; NPH = number of plants at harvest; NP = number of pods; HY = haulm yields; PDW= pods dry weight; GY: grain yield; W100G = weight of 100 grains. The numbers are the means ± standard errors of the parameters evaluated. P = probability according to ANOVA at a significance level of 5%. The means ± standard errors in the same column with the same letter do not differ significantly according to the Tukey HSD test at a significance level of 5%. $P < 0.05$: significant (S); $P \leq 0.01$: very significant (VS); $P \leq 0.001$ (HS): highly significant; $P \geq 0.05$: not significant (NS). on cowpea yield parameters at harvest.

Conclusion

The evaluation of the effects of different doses of compost on the agronomic performance of the *Komcallé* variety of cowpea and on soil fertility showed that compost inputs relatively improved the agronomic parameters of cowpea and soil fertility levels. Thus, the application of 1 t ha^{-1} of compost was more effective in improving the morphological parameters of cowpea, while the application of 3 t ha^{-1} of compost was more effective for physiological parameters, nodulation, and biomass production. Applying 2 t ha^{-1} of compost to zaï plots yielded the best cowpea grain yields and significantly improved the organic and chemical fertility of the soil. Looking ahead, in order to better understand the agronomic and pedological impact of compost and its processes in the soil, it would be necessary to study the dynamics of organic matter in these soils and and to evaluate the edaphic and climatic factors that influence this cropping system.

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Conflict of Interest

The authors do not have any conflict of interest.

Data Availability Statement

This statement does not apply to this article.

Ethics Statement

This research did not involve human participants, animal subjects, or any material that requires ethical approval.

Informed Consent Statement

This study did not involve human participants, and therefore, informed consent was not required.

Permission to Reproduce Material from other Sources

Not Applicable

Author Contributions

- **Koulibi Fidèle ZONGO:** Conceptualization, Methodology, Writing – Original Draft.
- **Mahamoudou KOUTOU and Eric OUEDRAOGO :** Writing – Review
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