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Research Article

Effects of cricket (Orthoptera: Gryllidae) frass on growth and nutrient content of the plant *Commelina petersii* Hassk

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ABSTRACT

Cricket frass, the excrement produced by crickets, is a natural waste of insect farming that offers a sustainable and cost-effective alternative to synthetic fertilizers for resource-limited farmers. This study investigated the effects of different cricket frass treatments on the growth and nutrient content of *Commelina petersii*, a valuable plant species for cricket insect rearing. Plants were grown in pot and field experiments with different cricket frass application rates—T_1 (0 t ha^{-1}), T_2 (5 t ha^{-1}), T_3 (10 t ha^{-1}), and T_4 (15 t ha^{-1}) in completely randomized and randomized complete block designs, respectively. Plant growth parameters (height, number of leaves, and biomass) and leaf nutrient concentrations were assessed. Results from both pot and field experiments demonstrated that cricket frass significantly enhanced *C. petersii* growth, with higher application rates leading to increased plant height and biomass. While the effect on number of leaves was less consistent, some positive impacts were noted. Nutrient analysis revealed that cricket frass led to higher dry matter (DM), crude protein (CP), ash, neutral detergent fiber (NDF), and calcium (Ca) content in the leaves, conversely decreasing nitrogen-free extract (NFE) content with increasing application rates. The optimal treatment of cricket frass for *C. petersii* was found to be T_4. This treatment not only supplied sufficient essential nutrients but also preserved acceptable forage quality. Therefore, these results strongly suggest that cricket frass represents a sustainable fertilizer with the capacity to boost *C. petersii* cultivation while simultaneously fostering cricket farming in resource-scarce areas.

INTRODUCTION

One of the main aspects of sustainable agriculture is to optimize crop production and restore soil fertility by reducing the negative impact of synthetic fertilizers on environment to match global food production (Farooq *et al.*, 2019; Timsina, 2018). Organic fertilizers offer economic and environmental advantages as sustainable agricultural solutions that reduce dependency on synthetic alternatives (Timsina, 2018). These organic nutrients are particularly valuable for promoting crop health, nutrition, and soil restoration due to their gradual nutrient release, which provides plants with a consistent supply of accessible nutrients aligned with their growth requirements (Wang *et al.*, 2018). Insect frass—the excrement from insect farming—is especially effective as its nutrients are readily absorbed by plants because of the unique physiological processes that determine the composition of insect waste (Poveda, 2021).

Cricket farming is expanding rapidly as a food source in East Africa (Tanga *et al.*, 2021), leading to the accumulation of large quantities of cricket frass. In 2021, small and medium-sized enterprises (SMEs) in Kenya and Uganda were estimated to produce over 30 tons of cricket powder annually (Tanga *et al.*, 2021). This figure has continued to increase in both countries since then. However, there is no available data quantifying the amount of waste—cricket frass produced per farm in East Africa in a year. This lack of data makes it difficult to meaningfully compare the frass output to other major cricket farming regions of the world like Southeast Asia, where a single medium-scale cricket farm in Thailand[1] can produce an average of 43 tons per year (Halloran *et al.*, 2017). This knowledge gap in East Africa's rapidly expanding cricket industry requires further studies, as many operations function as independent microenterprises with limited oversight. As the industry grows, cricket frass accumulation could pose environmental challenges requiring effective waste management strategies. The significant nutrient content in cricket frass—including nitrogen (2.0-2.6%), phosphorus (1.5-2.0%), potassium (1.8-2.3%), calcium (2.7-2.9%), magnesium (0.5-0.6%) and other essential nutrients (Beesigamukama *et al*., 2022; Halloran *et al.*, 2017)—makes it a promising biofertilizer for organic farming. Compared to frass from other insects like black soldier flies (BSF) and mealworms, cricket frass demonstrates superior slow-release nutrient properties, providing steady nutrition to plants while minimizing nutrient leaching risks (Beasley *et al.*, 2023; Poveda, 2021).

Despite cricket frass showing promise for sustainable agriculture, studies examining its effects on plant growth in developing regions like Sub-Saharan Africa are limited. The potential of cricket frass as a biofertilizer needs investigation since it enhances both crop performance and the physico-chemical properties of soil. For instance, studies by Ogaji *et al.* (2022) showed that cricket frass enhances soil fertility and promotes growth in spring onion (*Allium fistulosum* L.), while Wanjugu *et al.* (2023) found that it improves vegetative development in spider plant (*Cleome gynandra* L.). Regarding cricket dietary preferences, study shows crickets strongly favor *Commelina petersii* over other *Commelina* species due to its more balanced nutritional profile (Runyambo *et al.*, 2023). This is because *C. petersii* contains a more balanced nutritional profile, making it better food source. To improve the quality of this favored food plant, soil amendments such as cricket frass can enhance both growth and nutritional value (Bukari *et al.*, 2021). However, determining the ideal application rates of cricket frass for *C. petersii* is essential to maximize the benefits of this organic fertilizer. By enhancing its growth and nutrient content using cricket frass, farmers can produce higher yields of this nutritious plant to sustain their cricket populations (Ohja *et al.*, 2020; Velenturf and Purnell, 2021). Therefore, studying cricket frass as an organic fertilizer for *C. petersii* has significant implications for developing sustainable, locally-sourced feed solutions for the growing edible insect industry.

This study investigated the effects of different cricket frass application rates on the growth and nutrient contents of *Commelina petersii*, commonly known as "Peters dayflower." This plant species is an important forage in Sub-Saharan Africa grow and survive near rivers, lake and rarely under cultivation areas up to 1450 m above sea level (a.s.l.) in East Africa (Faden, 2012).

[1] Waste estimation in Thailand included cricket excrement in addition to any other matter such as uneaten feed, small body parts, wings, and shredded eggs cartons.

MATERIAL AND METHODS

Experimental site

This study was conducted at the Jaramogi Oginga Odinga University of Science and Technology (JOOUST) crop farm in Bondo sub-county, Western Kenya, during the 2022 growing season. This region receives 900-1600 mm of annual rainfall. The experimental location was situated at N 0° 5' 29.328" latitude and E 34° 15' 27.2874" longitude, at approximately 1,200 meters above sea level. The organic fertilizer utilized in this research was cricket frass sourced from field crickets (*Scapsipedus icipe*), which were nourished with a diet of chicken mash (provided by Unga Farm Care - East Africa - Ltd FUNGO®, Nairobi, Kenya) and sweet potato vines.

Plant materials

Commelina petersii plants were collected from an agricultural production site in Abawa, Siaya, Western Kenya (S 0° 8' 5.2152" latitude and E 34° 8' 10.212" longitude) as documented by Runyambo *et al.* (2022). Before initiating the experiment, the collected plants underwent a one-month domestication period at the University crop farm in three replicated 1 m × 1 m plots. The plants received daily watering with no application of pesticides or fertilizers during this acclimatization period.

Photo of the plant *Commelina petersii* at field level, 4 Week After Transplanting (WAT). Copyright© Runyambo Irakiza, Field work in 2022

Soil and frass analysis

The predominant soil type in Bondo sub-county was identified as cutanic plinthic Acrisol according to the World Reference Base for soil resources (FAO, 2006; Karuma, 2019), with sandy-loam texture at JOOUST. Soil analysis included measurements of pH, electric conductivity, total and organic carbon, total nitrogen, available phosphorus, exchangeable calcium, magnesium, potassium, and soil texture (proportions of silt, clay, and sand). Frass analysis measured similar elements, adding sodium, manganese, zinc, iron, and copper.

Total carbon (TC), organic carbon (OC), total nitrogen (TN), available phosphorus (Av. P), exchangeable calcium (Ca), magnesium (Mg), potassium (K), and soil texture components were expressed as percentages. Electric conductivity was measured in decisiemens per meter (dS/m). Exchangeable sodium (Na), copper (Cu), manganese (Mn), iron (Fe), and zinc (Zn) were quantified in milligrams per kilogram (mg kg^{-1}). Following Varley (1972), soil pH and electric conductivity were measured using a pH meter and conductivity meter, respectively, in a 1:2.5 (w/v) soil-water suspension. Following AOAC methods (AOAC, 1998), exchangeable calcium, magnesium, copper, manganese, iron, zinc, potassium, and sodium were extracted using 1N ammonium acetate at pH 7. The concentrations of calcium, copper, manganese, iron, zinc, and magnesium were quantified by atomic absorption spectrophotometry (AAS), and potassium and sodium levels were assessed using flame photometry. Total carbon and organic carbon were assessed using standard methods by Nelson and Sommers (1996), and total nitrogen and available phosphorus were determined according to procedures described by Bremmer and Mulvaney (1982) and Mehlich (1984), respectively. The analysis of soil texture was performed utilizing the Hydrometer method (Bouyoucos, 1951). Table 1 provides comprehensive soil characteristics for the experimental site.

Table 1: Chemical characteristics of soil prior the experiment and composition of cricket frass used presented as mean (±SE)

Parameters	Soil	Frass
pH	6.4±0.2	7.9±0.00
Ec (dS/m)	0.25±0.01	2.20±0.04
TC (%)	1.32±0.04	-
OC (%)	1.01±0.03	25.4±0.3
TN (%)	0.09±0.03	2.16±0.05
Av. P (%)	0.0019±0.0001	0.79±0.02
Ca (%)	0.03±0.01	0.38±0.01
Mg (%)	0.0032±0.0002	0.15±0.02
K (%)	0.0156±0.0002	0.98±0.03
Na (mg. Kg^{-1})	-	160±0.002
Mn (mg. Kg^{-1})	-	310±0.002
Zn (mg. Kg^{-1})	-	50±0.0002
Cu (mg. Kg^{-1})	-	10±0.0002
Fe (mg. Kg^{-1})	-	90±0.0001
Sand (%)	63±4.00	-
Silt (%)	15±2.00	-
Clay (%)	22±3.00	-

Photo of Cricket frass dried at JOOUST insect farm after being composted. Copyright© Runyambo Irakiza, Field work in 2022

Experimental design

Pot experiment

A pot experiment was implemented to evaluate different application rates of cricket frass manure on *C. petersii* plant growth. Cricket frass treatments included: T_1 (0 t ha^{-1}), T_2 (5 t ha^{-1}), T_3 (10 t ha^{-1}), and T_4 (15 t ha^{-1}), with T_1 (0 t ha^{-1}) serving as a control treatment. The experiment followed a Completely Randomized Design (CRD) with four replications. The study utilized sixteen 15 L pots (40 cm diameter) with drainage holes at the bottom. Each pot was filled with a 2:1 v/v mixture of sand and loam soil. Ten plantlets at three-leaf stage were transplanted into each pot two weeks following application of the frass.

Field experiment

The field experiment utilized a Randomized Complete Block Design (RCBD) replicated four times. Well-composted cricket frass (aged three months) was incorporated into the soil two weeks prior to transplanting. Three-leaf stage *C. petersii* seedlings were then transplanted into the field. The two-week interval between frass application and transplanting allowed sufficient time for natural decomposition and nutrient release from the manure, ensuring nutrient availability at transplanting time. Each 9 m^2 plot contained 36 seedlings planted with 50 cm spacing between rows and 5 cm from the first hill. Treatments were separated by 1 m distance, while replications were spaced 2 m apart (Figure 1). To maintain optimal growing conditions, plants were irrigated twice daily to field capacity, weeds were manually removed weekly, and consistent pest control measures were implemented throughout the experimental period.

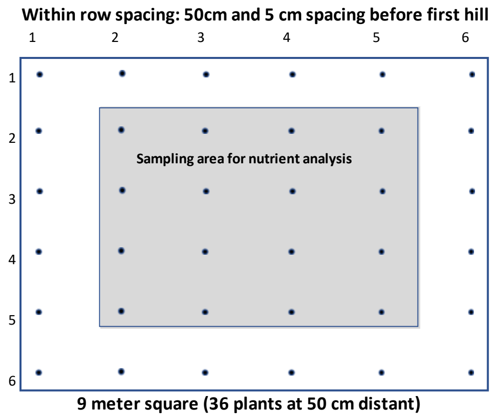


Figure 1. Detail of a plot with dots indicating *Commelina* hills and grey area indicating sampling area at central harvest.

Growth data

In the pot experiment, measurements were taken from five centrally located plants. In field conditions, growth parameters (height, number of leaves, and fresh/dry leaf weight at harvest) and leaf nutrient sampling of *C. petersii* were collected from the central harvest area. Data were gathered from 16 plants (Figure 1). Height of *C. petersii* was measured from the plant base to the tip using a plastic ruler (cm) at two-week intervals beginning from the second week after transplanting (WAT). Number of leaves were conducted by tallying all leaves on each plant at two-week intervals starting from the second WAT. Fresh leaf weight was determined at the experiment's conclusion (8 WAT) in both pot and field conditions. Sixteen plants from the central harvest area in field conditions and five centrally located plants in pots were weighed separately for each treatment using an electrical balance. Before measuring dry weight, harvested fresh leaves were oven-dried at 65°C for 24 hours.

Proximate analysis and NDF

At week four following transplantation, a proximate analysis of leaves was conducted using 5 g powdered samples (Kirk and Sawyer, 1980). The study evaluated moisture content (converted to dry matter - DM), ash (ASH), crude protein (CP), ether extract (EE), crude fiber (CF), and nitrogen-free extract (NFE). Moisture content was measured by heating samples at 105°C for 12 hours, while ash content was determined through sample incineration at 550°C. Crude protein was calculated using the Kjeldahl method, and ether extract was identified through diethyl ether extraction. NFE was obtained by subtracting the previous measurements from 100%. All analyses were performed using standard AOAC methods, with Neutral Detergent Fiber (NDF) assessed according to Van Soest and Robertson's (1985).

Determination of leaf Ca mineral

Leaf calcium content was assessed four weeks after transplanting (WAT) by ashing 1 gram of leaf powder and digesting it in a 3:1 mixture of hydrochloric and nitric acids. This was followed by dilution with 100 ml of distilled water. The calcium content was then measured using atomic absorption spectrometry (AAS) in accordance with AOAC methods.

The current study emphasized calcium and NDF parameters based on the procedure described by Runyambo *et al.* (2023) for evaluating *Commelina* species as cricket feed.

Data analysis

Microsoft Excel 2021© was used for data recording and compilation of growth parameters (height, number of leaves, fresh/dry leaf weight at harvest) and leaf nutrient content. The data were then assessed for homoscedasticity and normality according to Sokal and Rohlf (1995) before statistical analysis. To determine significant differences among treatments, growth data and leaf nutrient measurements were analyzed using ANOVA, followed by Tukey's HSD test for multiple mean comparisons when significant differences were detected. STATA 14.2 software was used for the analysis of height, number of leaves, and leaf nutrient content at a significance level of $\alpha = 0.05$. Finally, Prism Software (version 8.0.2) was employed to generate graphical representations and test treatment differences in fresh and dry leaf weights across various significance thresholds ($\alpha = 0.0001, 0.001, 0.01$, and 0.05).

RESULTS AND DISCUSSION

Height of *C. petersii*

All treatments significantly enhanced plant height in both pot and field experiments, with measurements beginning at week 4 for the pot experiment and week 2 for the field experiment ($p = 0.0002$ and $p = 0.0349$, respectively) (Table 2). Plants treated with T_4 (15 t ha^{-1}) consistently demonstrated the greatest height. This indicates that cricket frass improved soil fertility, thereby promoting *C. petersii* growth. These results are consistent with findings by Ogaji *et al.* (2022), who documented significant height increases in plants treated with cricket frass. The observed height increase in treated plants can be attributed to higher available phosphorus concentrations, which play a vital role in cell division and enlargement. *Commelina* species are known to respond favorably to agricultural inputs (Isaac *et al*., 2013; Riar *et al*., 2016) due to their fibrous root system that facilitates efficient nutrient absorption.

Table 2: Effect of different treatments on height (cm) of *C. petersii* recorded between an interval of two weeks. Data are presented as mean (± SE), with Chi-square value ($\chi 2$), Degree of freedom (Df) and Probability level (p)

	Treatment	Week 2	Week 4	Week 6	Week 8
Pot	T_1	15 ± 1.07^{a}	41 ± 1.85^{a}	64 ± 3.69^{ab}	110 ± 3.98^{a}
	T_2	16 ± 0.96^{a}	47 ± 1.65^{ab}	62 ± 3.30^{a}	120 ± 3.56^{ab}
	T_3	18 ± 1.24^{a}	53 ± 2.14^{bc}	65 ± 4.26^{ab}	123 ± 4.60^{b}
	T_4	18 ± 1.07^{a}	58 ± 1.85^{c}	78 ± 3.69^{b}	128 ± 3.98
	$\chi 2$	0.5833	2.6677	6.2968	1.4267
	Df	3	3	3	3
	P	0.1641	0.0002	0.0421	0.049
Field	T_1	16 ± 0.57^{ab}	34 ± 2.26^{a}	54 ± 3.22^{a}	86 ± 1.71^{a}
	T_2	15 ± 1.51^{a}	36 ± 2.51^{a}	52 ± 2.95^{a}	83 ± 2.89^{a}
	T_3	17 ± 1.41^{ab}	38 ± 2.46^{a}	59 ± 3.18^{a}	90 ± 2.48^{a}
	T_4	22 ± 2.49^{b}	58 ± 1.90	84 ± 3.22	111 ± 5.02
	$\chi 2$	4.58	0.23	0.02	3.04
	Df	3	3	3	3
	P	0.0349	0.0001	0.0001	0.0002

Note: Means followed by the same superscript letter did not differ significantly at a probability level ($p < 0.05$).

Number of leaves of *C. petersii*

While treatments influenced leaf production in both experimental settings, the effects were more pronounced in field conditions. Potted plants exhibited a significant increase only at week 8 ($p = 0.007$), whereas field-grown plants showed significant effects earlier at week 4 ($p = 0.0378$) (Table 3), with no subsequent significant differences. This suggests that field conditions, including greater competition for resources or environmental variations, may have influenced leaf development patterns. The comparison of our results with prior studies on different plant species (Bukari *et al*., 2021; Wanjugu *et al*., 2023) highlights the possibility of species-specific reactions to cricket frass application. While our study focused exclusively on *C. petersii*, additional research on a wider range of species is needed to confirm this hypothesis.

Table 32: Effect of different treatments on number of leaves of *C. petersii* recorded between an interval of two weeks. Data are presented as mean (± SE), with Chi-square value ($\chi 2$), Degree of freedom (Df) and Probability level (p)

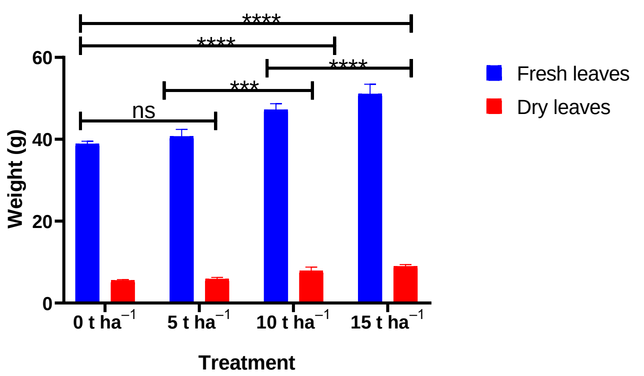
	Treatment	Week 2	Week 4	Week 6	Week 8
Pot	T_1	6 ± 0.47^{a}	22 ± 1.84^{a}	54 ± 8.18^{a}	71 ± 1.03^{ab}
	T_2	5 ± 0.47^{a}	23 ± 4.81^{a}	53 ± 4.17^{a}	68 ± 2.05^{a}
	T_3	5 ± 0.40^{a}	24 ± 2.48^{a}	55 ± 8.10^{a}	75 ± 1.84^{ab}
	T_4	6 ± 1.00^{a}	24 ± 3.01^{a}	63 ± 5.52^{a}	77 ± 0.75^{b}
	$\chi 2$	2.9903	2.6241	1.5156	3.1778
	Df	3	3	3	3
	P	0.6811	0.9256	0.6821	0.0070
Field	T_1	11 ± 0.47^{a}	46 ± 1.25	131 ± 1.22^{a}	173 ± 2.48^{a}
	T_2	11 ± 0.47^{a}	43 ± 3.06	134 ± 1.47^{a}	174 ± 1.75^{a}
	T_3	13 ± 0.86^{a}	52 ± 2.41^{a}	131 ± 1.88^{a}	179 ± 2.62^{a}
	T_4	13 ± 0.86^{a}	52 ± 2.41^{a}	131 ± 1.88^{a}	179 ± 2.62^{a}
	$\chi 2$	1.75	1.86	0.65	0.52
	Df	3	3	3	3
	P	0.1557	0.0378	0.5436	0.2487

Note: Means followed by the same superscript letter did not differ significantly at a probability level ($p < 0.05$).

Fresh/dry weights at harvest

Treatments significantly increased both fresh and dry leaf weights in pot and field experiments ($p < 0.0001$ and $p < 0.001$, $p < 0.0001$ and $p < 0.01$, respectively, Figure 2). Plants treated with T_4 consistently produced the greatest biomass. These results suggest that cricket frass enhanced nutrient uptake, which led to increased plant growth and biomass production.

(a)



(b)

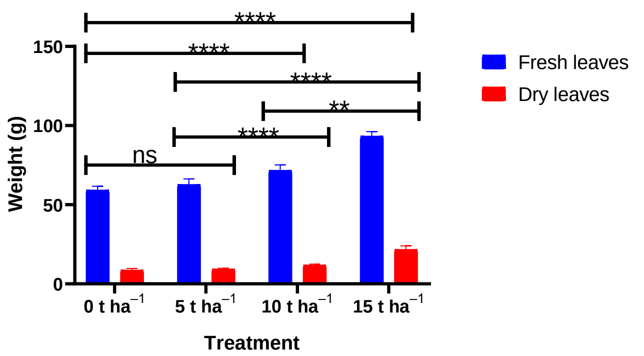


Figure 2: Relative fresh/dry weights of *C. petersii* at harvesting in pot experiment (a) and field experiment (b)

Note: Significant differences are denoted as follows: **** where $p < 0.0001$, *** where $p < 0.001$, ** where $p < 0.01$, * where $p < 0.05$, and ns indicating not significant ($p > 0.05$).

Proximate analysis and determination of Ca and NDF

Proximate analysis components were significantly affected ($p < 0.05$) by all treatments in both pot and field experiments. Dry matter (DM) ranged from 87.17 to 90.88% (Table 4), while all treatment significantly impacted crude protein (CP), ash, calcium (Ca), neutral detergent fiber (NDF), ether extract (EE), and nitrogen-free extract (NFE) levels. In the pot experiment, treatment T_3 increased CP, NDF, and EE contents, while T_4 rate enhanced Ca and ash contents. The control treatment T_1 yielded higher NFE content. In the field experiment, all treatment T_2, T_3 and T_4 increased CP, ash, Ca, and NDF contents compared to the control T_1, which showed higher NFE values. The observed increase in CP resulting from cricket frass application can be attributed to enhanced nitrogen uptake, consistent with findings by Bukari *et al.* (2021). Nitrogen is essential for protein synthesis and nucleic acid formation. Nitrogen's role in shaping fiber quality is highlighted by the variations in NDF content across treatments. Supporting evidence from studies on cereals and legumes (Linn and Martin, 1991; Liu *et al.*, 2023) indicates that higher NDF typically corresponds to lower forage quality, a trend observed in our study where cricket frass-treated plants exhibited elevated NDF compared to untreated plants. This suggests a decline in forage quality due to nitrogen-induced changes in fiber composition. Nevertheless, a specific amount of fiber remains essential for proper rumen function in animals, contrasting with its negative association in feed evaluation. Also, it was observed that cricket frass application likely enhanced soil Ca availability, resulting in greater Ca uptake by *C. petersii*. This aligns with previous studies indicating that cricket frass contains high levels of calcium (e.g., Beesigamukama *et al.*, 2022; Halloran *et al.*, 2017), with current values representing reasonable levels for this type of amendment. General, the T_4 treatment provided optimal levels of CP, Ca, and NDF for *C. petersii* cultivation, establishing it as the most appropriate rate for this plant species.

Table 4: Effect of different rates of cricket frass manure on proximate analysis elements, Ca mineral and NDF Data are presented as mean (± SE), with Chi-square value ($\chi 2$), Degree of freedom (Df) and Probability level (p). The number of samples for each parameter was n = 2

Treatment	DM (%)	ASH (%)	EE (%)	CP (%)	NFE (%)	NDF (%)	Ca (%)
				Pot			
T_1	88.92±0.02	14.41±0.005	2.22±0.02	23.11±0.01	53.00±0.09	50.15±0.03	5.14 ± 0.02^{a}
T_2	89.40±0.02	15.17±0.005	3.34±0.03	25.15±0.07	50.18±0.06	54.60 ± 0.29^{a}	5.18 ± 0.01^{a}
T_3	90.40±0.02	16.25±0.005	4.05±0.03	26.71±0.15	49.25 ± 0.005^{a}	58.56 ± 0.55^{a}	5.68 ± 0.49^{a}
T_4	90.88±0.48	17.71±0.00	3.70±0.01	27.22±0.01	49.12 ± 0.03^{a}	53.63±0.27	9.14±0.03
$\chi 2$	0.39	1.00	1.01	4.25	3.68	3.28	9.57
Df	3	3	3	3	3	3	3
p	0.0001	0.0001	0.0001	0.0001	0.0001	0.0003	0.0009
				Field			
T_1	87.17±0.06	15.38±0.02	4.22 ± 0.02^{ab}	24.44±0.42	40.6±0.37	52.89±0.56	6.14 ± 0.02^{a}
T_2	88.43 ± 0.05^{a}	16.47±0.24	5.21 ± 0.10^{bc}	26.31 ± 0.04^{a}	36.72 ± 0.50^{b}	58.77 ± 0.12^{a}	6.90 ± 0.01^{a}
T_3	89.49 ± 0.27^{ab}	17.44±0.11	5.31 ± 0.33^{c}	26.83 ± 0.33^{ab}	35.22 ± 0.09^{ab}	59.08 ± 0.04^{a}	8.49 ± 0.37^{b}
T_4	90.37 ± 0.31^{b}	18.96±0.15	3.89 ± 0.10^{a}	27.92 ± 0.08^{b}	34.11 ± 0.04^{a}	55.37±0.18	8.55 ± 0.02^{b}
$\chi 2$	2.69	3.18	3.89	7.16	4.08	3.96	9.53
Df	3	3	3	3	3	3	3
p	0.0015	0.0003	0.0113	0.0014	0.0005	0.0003	0.0018

Note: Means followed by the same superscript letter did not differ significantly at a probability level ($p < 0.05$). Given the emphasis on NDF in this study, crude fiber (CF) was not included in the statistical analysis.

CONCLUSION

This study demonstrates that cricket frass is a valuable organic amendment for enhancing the growth and nutrient content of *C. petersii*. The tested treatments T_2, T_3 and T_4 all produced significant enhancements in plant height, biomass production, leaf development, and nutrient profile when compared to the untreated control. Although effects on leaf production showed some variability across experimental conditions, cricket frass application consistently enhanced nutrient uptake, resulting in elevated levels of DM, Ca, NDF, CP, and ash content. Conversely, NFE levels decreased proportionally with increasing cricket frass application rates. Based on comprehensive analysis, T_4 treatment emerged as the optimal application rate for *C. petersii*, providing sufficient quantities of essential nutrients while maintaining reasonable forage quality characteristics. These results underscore cricket frass's potential as a sustainable, nutrient-rich organic fertilizer for *C. petersii* cultivation, particularly valuable in resource-constrained environments such as Sub-Saharan Africa. Promoting these sustainable farming practices among cricket producers can create optimal growing conditions for this important plant species.

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Author contributions

Runyambo Irakiza conceived the study, oversaw data acquisition and analysis, and drafted the manuscript. Andika Darius, Arnold Watako, and Mwonga Samuel provided input and contributed to the final manuscript.

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