Growth, Yield, and Nutrient Consumption Responses of Old and Newly Released Cassava Varieties

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Abstract
Cassava is a major staple worldwide and cultivated in a marginal to nutrient rich soil. However, there are varietal differences in cassava productivity across locations thereby reducing productivity, which has necessitated the continual development of new varieties that are more stable at different environments. This study thus assessed the growth and yield, and nutrient changes of three newly released and 2 old cultivated cassava varieties in the grown environment. The five varieties were planted out in a randomized complete block design with three replicates. Pre and varietal-post soil physic-chemical parameters were assessed using standard procedures. Data were taken on the plant height (PH), leaf area (LA), number of roots tubers (NOR), tuber weight (TW), and changes in macro and micro elements. All data were analysed using descriptive statistics and analysis of variance, while means were separated using least significant differences at 5% significance level. The PH, and LA differed significantly between varieties and ranged from 31.67±1.90 (TME-419) to 45.67±1.90 cm (Give-me-chance), 42.82±4.14 cm^2 (Game changer) to 58.85±4.14 cm^2 (TME-419). The NOR and RW ranged from 3.00±0.73 (Nwaugo) to 5.33±0.73 (TME-419), and 441.7±253.01 g (Give-me-chance) to 1533.30±253.01 (TME-419 and Game changer). The changes in nitrogen, phosphorus, calcium, magnesium and potassium ranges from -0.11 (Give-me-chance-plots) to 0.11 (Game changer-plots), -5.62 (TME-419-plots) to 10.37 (Hope-plots), -0.51 (Give-me-chance-plots) to 0.47 (TME-419-plots), -0.16 (Game changer-plots) to 012 (TME-419), and from -0.06 (Hope-plots) to 0.14 (TME-419-plots), respectively. Newly released varieties produced heavier tubers released varieties relative to the old varieties which depleted more soil nutrients.

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Keywords: *Manihot esculenta*, Varietal release, Agronomic trait, Productivity

Introduction

Cassava (*Manihot esculenta* Crantz) is a major staple crop cultivated primarily in tropical and subtropical regions, where it plays a vital role in food security, income generation, and industrial applications (Bilong *et al.*, 2022) [5]. Globally, cassava ranks as the fourth most important staple crop after rice, wheat, and maize, providing carbohydrates for over 800 million people, particularly in sub-Saharan Africa, Asia, and Latin America (FAO, 2022). Its adaptability to marginal soils, tolerance to drought, and ability to yield reasonably well under suboptimal conditions make it an indispensable food security crop (Howeler, 2017) [8]. However, despite its economic and nutritional significance, cassava yields remain suboptimal due to several agronomic

constraints,
including soil fertility depletion, limited adoption of improved varieties, and suboptimal nutrient management practices (Manogaran *et al.*, 2022) [10].
The major challenge facing cassava production is the declining soil fertility in many production areas, which significantly impacts yield and quality. This problem is exacerbated by the continuous cultivation of cassava on the same land without adequate nutrient replenishment, leading to nutrient depletion and reduced productivity. Additionally, while improved cassava varieties have been developed and released, their yield potential varies under different soil fertility management strategies (Adu *et al.*, 2025). The rate of nutrient depreciation rate as a result of the growth and yield of cassava varieties has not been comprehensively evaluated, making it essential to understand their impact on old and newly released varieties of cassava (Akanbi *et al.*, 2018).
Focusing on sustainable nutrient management in cassava cultivation will aid in the development of best practices for improved productivity and resilience in cassava farming as cassava is a crucial crop for food security and industrial applications, making its productivity an essential concern for agricultural development (Howeler, 2020). With increasing global demand for cassava and its derivatives, enhancing its yield potential through effective soil fertility management is imperative (Pypers *et al*., 2011) [13]. Given the rising cost of synthetic fertilizers and their potential negative environmental impacts, alternative and sustainable nutrient management strategies must be explored (Vanlauwe *et al.*, 2015). Understanding how different cassava varieties respond to organic and inorganic nutrient sources will provide valuable insights for farmers, researchers, and policymakers. This study will contribute to the development of sustainable cassava production practices that enhance productivity and soil health while minimizing environmental degradation (Aravind *et al.*, 2019) [2].
The general objective of this study is to evaluate the growth and yield response of old and newly released cassava varieties to organic and inorganic nutrient sources, while the specific objectives are to compare the growth and yield performance of old and newly released cassava cultivars, and determine the nutrient status of the cultivars specific grown plots.

Materials and Methods

Experimental Location: The experiment was conducted at the Faculty of Agricultural Sciences Research Farm, situated at Campus III site with coordinates; latitude 5.7855° N, and longitude 6.1184° E.

Experimental materials / sources: The following materials were used for this study;

1. **Cassava varieties:** Two old released varieties (Nwaugo and Give-me-chance) and three newly released cassava varieties (Hope, Game Changer, and TME419) were sourced from the Go-Seed Unit of the International Institute of Tropical Agriculture, IITA, Ibadan.
2. **Nutrient sources:** Two organic manure sources (Fish effluent, and Poultry manure), and one inorganic fertilizer (NPK 15:15:15) was used for this study.

Fish effluent was sourced from the fish farm of the Department of Fisheries, Delta State University, Abraka. The effluent was directly used in fertigating the plants. Poultry Manure was sourced from the poultry waste deposit of the Department of Animal Science poultry farm, Faculty of Agriculture, Delta State.

Farm preparation, planting and maintenance: The allotted farmland were cleared of all vegetation, packed and burnt. The land was marked into plots of 5m by 4m, with each plot carrying a treatment unit. The cassava stems were cut into 20 cm each, and the prepared land was dug and the 20 cm stem sizes placed on the shallowly dug holes and covered. Two months after planting, the poultry manure and cow dung, and NPK 15:15:15 were applied to the plots at a rate of 400 kg per hectare. The farmland was kept weed-free by clearing the farm of all weeds once bi-monthly.

Soil sample collection and analysis: Soil samples were collected on cultivar specific plots before planting (pre), and after the first season harvest (post), dried and sent to the soil analytical laboratory, Soil Science Department, University of Ibadan for soil physic-chemical parameters determination following standard procedures.

Experimental design: The experiment was a 5(Cassava varieties) by 3(nutrient sources) factorial laid in a Randomized Complete Block Design (RCBD) and replicated three times with 5 unit stands per replicate.

Data collection and statistical analysis: The following data were collected;

Agronomic data

1. Plant height at 2, 4, 6, 8, 10, and 12 weeks after planting
2. Number of leaves at 2, 4, 6, 8, 10, and 12 weeks after planting
3. Leaf area at 2, 4, 6, 8, 10, and 12 weeks after planting

Yield data: At harvest, the following data were collected;
1. Fresh tuber weight (Kg) per plot, and converted to ha following the formula below;
1 ha = 10000 m^2,
20 m^2 = 20/10000 m^2 = 0.002 ha,
Hence, yield per 20 m^2 x 500 = 1 ha equivalence.
2. Number of tubers per stand
Changes in soil nutrient status was determined by directly subtracting the initial varietal-specific soil nutrient value from the post varietal-specific plot nutrient status.

Data analysis

Data collect were analyzed using Analysis of Variance (ANOVA), and the differences in treatment means were separated using Least Significant Differences at 5% level of significance.

Results

Results obtained on the plant height showed a progressive increment in the height of the cassava plants, while at the 14

WAP, Give-me-chance was the tallest variety (44.00±1.18) cm and it was significantly taller than the rest varieties, except Hope (41.50±1.18) cm (Table 1). However, there were no significant differences between the two seasons of cultivation, and the interaction between the varieties and season of cultivation.

Table 2 showed a progressive increase in the number of leaf produced by the cassava plants with respect to the cultivated varieties and the season of cultivation. At 14 WAP, Give-me-chance produced the highest number of leaves (32.00±0.92) which was significantly higher than the rest varieties except Hope (30.67±0.92). However, there were no significant differences between the two seasons of cultivation, except at the 10th WAP, the number of leaves produced in season two was significantly higher than season one. The interaction between the varieties and season of cultivation on leaf production was significant 8 WAP.

The leaf area increased gradually in size from the 4th to 14th WAP, and at the 10th WAP, the leaf area of the cassava plants cultivated in season one (27.12±0.84) was significantly higher than the first season (24.41±0.84), while at 14 WAP, Game changer produced the largest leaves (62.87±2.76) cm^2 which was significantly larger than the rest varieties (Table 3). There were no significant differences in the leaf area produced from the 4th to the 14th WAP.

Table 4 showed that the number of roots produced in the first season (5.73±0.39) was significantly higher than the second season (4.27±0.39). On the varieties cultivated, TME-419 produced the highest number of tubers (6.33±0.62) which was significantly higher than the rest varieties except Hope (5.00±0.62) and Game changer (5.33±0.62). On the root weight, Game changer produced the heaviest weight (31.78±1.62) t/ha which was significantly heavier than Nwaugo (15.54±1.62) t/ha and Give-me-chance (14.32±1.62) t/ha.

Table 1: Average plant height (cm) of cassava cultivars at 4th to 14th weeks after planting for 2024 and 2025 planting seasons

Category	Treatment	Week 4	Week 6	Week 8	Week 10	Week 12	Week 14
Season	One	8.58a	10.17a	14.01a	14.32a	25.33a	39.87a
	Two	8.22a	10.63a	13.98a	13.89a	24.67a	38.67a
	LSD (0.05)	1.02	0.95	0.83	1.88	1.48	2.19
	SE	0.35	0.32	0.28	0.64	0.50	0.74
Variety	TME-419	10.65a	11.52a	12.85c	14.53a	23.83b	33.00c
	Nwaugo	5.08d	7.62c	14.33ab	15.08a	24.00ab	38.83b
	Give-me-chance	7.65c	9.37b	13.35bc	13.57a	25.00ab	44.00a
	Hope	8.72bc	11.88a	14.53ab	12.35a	25.83ab	41.50ab
	Game changer	9.90ab	11.60a	14.92a	15.00a	26.33a	39.00b
	LSD (0.05)	1.62	1.49	1.32	2.97	2.34	3.47
	SE	0.55	0.53	0.42	1.02	0.79	1.18
Interaction	Variety × Season	1.05ns	4.25ns	0.33ns	6.57ns	0.08ns	14.38ns

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences, SE: Standard error

Table 2: Average number of leaves of cassava cultivars at 4th to 14th weeks after planting for 2024 and 2025 planting seasons

Seasons	Week 4	Week 6	Week 8	Week 10	Week 12	Week 14
One	11.93a	10.73a	13.57a	14.40b	18.87a	28.47a
Two	8.33b	9.67b	13.07a	15.60a	20.07a	28.93a
LSD(0.05)	0.98	1	0.87	0.94	1.87	1.71
SE	0.33	0.34	0.29	0.32	0.63	0.58
Varieties						
TME-419	10.67bc	11.50a	12.42b	16.67a	17.50c	25.17d
Nwaugo	5.67d	4.33c	14.50a	17.00a	18.00bc	26.83cd
Give-me-chance	11.67ab	13.00a	13.50ab	14.33b	20.17abc	32.00a
Hope	12.67a	12.67a	13.33ab	13.83b	20.67ab	30.67ab
Game changer	10.00c	9.50b	12.83b	13.17b	21.00a	28.83bc
LSD(0.05)	1.55	1.59	1.37	1.49	2.95	2.71
SE	0.53	0.54	0.45	0.51	1	0.92
Variety X Season	1.62ns	1.92ns	22.20*	0.22ns	0.72ns	1.22ns

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences, SE: Standard error

Table 3: Average leaf area (cm^2) of cassava cultivars at 4th to 14the weeks after planting for 2024 and 2025 planting seasons

Seasons	Week 4	Week 6	Week 8	Week 10	Week 12	Week 14
One	13.20a	14.84a	20.64a	24.41b	36.76a	50.29a
Two	13.47a	13.35a	22.05a	27.12a	41.45a	54.18a
LSD(0.05)	2.14	2.54	2.63	2.48	7.11	5.16
SE	0.72	0.86	0.89	0.84	2.41	1.75
Varieties						
TME-419	15.88ab	15.17ab	27.88a	30.23b	39.90a	43.77c
Nwaugo	8.48c	6.83c	18.65b	35.40a	43.57a	52.12b
Give-me-chance	16.88a	17.55a	25.35a	26.82b	45.70a	50.96bc
Hope	16.44ab	13.24b	18.96b	19.37c	43.22a	51.47bc
Game changer	12.84b	13.88b	15.90b	17.02c	23.12b	62.87a
LSD(0.05)	4.02	3.38	4.16	3.93	11.25	8.15
SE	1.36	1.15	1.41	1.33	3.81	2.76
Variety X Season	0.23ns	9.80ns	3.74ns	2.56ns	3.17ns	9.38ns

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences, SE: Standard error

Table 4: Average number of roots and root weight (t/ha) of cassava cultivars at 4th to 14the weeks after planting for 2024 and 2025 planting seasons

Seasons	Number of roots	Root weight
One	4.27b	22.02a
Two	5.73a	24.81a
LSD(0.05)	1.16	4.88
SE	0.39	1.65
Varieties		
TME-419	6.33a	27.77a
Nwaugo	3.83b	15.54b
Give-me-chance	4.50b	14.32b
Hope	5.00ab	27.67a
Game changer	5.33ab	31.78a
LSD(0.05)	1.82	7.72
SE	0.62	1.62
Variety X Season	0.22ns	28.92ns

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences, SE: Standard error

There were no significant differences between the time of soil analysis in the sand, silt, and clay contents (Table 5). However, the organic content of the pre soil analysis (3.12±0.01) was significantly higher than the post soil status (3.06±0.01). On the cultivars grown plots, the sand content of the Nwaugo grown plots (86.00±1.12) was highest, and it was significantly higher than the rest cultivar-specific grown plots except the plots Hope cultivar was grown (83.33±1.12). The Give-me-chance cultivated plots had the highest silt content (9.00±0.43) which was statistically similar with the rest cultivar specific grown plots except Nwaugo grown plots (5.00±0.43). However, the clay content of Game changer specific grown plots (11.23±0.38) was significantly higher than the rest cultivars grown plots. Also, the highest organic content was observed in the Game changer grown plots (3.86±0.02), and it was significantly higher than the rest cultivars specific grown plots. The interaction between the cultivars and time of soil test was significant on the organic carbon.

The manganese, Iron, copper, and zinc contents in the pre soil status (57.23±0.69), (94.91±0.38), (1.44±0.01), and (3.51±0.06), respectively were significantly higher than the post soil status (Table 6). On the cultivars grown plots, the Game changer plots had the highest manganese (66.77±0.89) ppm and iron (104.47±0.49) ppm contents, and they were each significantly higher than the rest cultivar plots. The highest copper content (1.52±0.01) was observed in the Nwaugo grown plots which was significantly higher than the rest plots except Hope grown plots. However, the highest zinc content (3.84±0.07) was found in the TME-419 grown plots, which was significantly higher than the rest cultivar-specific plots. The interaction between the time of soil test and cultivars was significant on the iron and copper contents.

The nitrogen (0.35±0.01), phosphorus (17.38±0.17), calcium (2.90±0.01), magnesium (1.21±0.01), and potassium (0.41±0.01) contents observed in the pre soil samples, were all significantly higher than the post soil samples (Table 7). On the cultivar-specific plots, Game changer grown plots had the highest nitrogen (0.46±0.01) and sodium (0.31±0.01) contents, while Hope grown plots had the highest phosphorus content (27.75±0.22) which were both significantly higher than the contents of other cultivar grown plots. However, the highest calcium (3.37±0.02), magnesium (1.33±0.01), and potassium (0.52±0.01) contents were observed in the TME-419 grown plots, and it was significantly higher than the rest cultivars-specific grown plots. The interaction between the time of soil test and cultivars was significant on the phosphorus and calcium contents.

Table 5: Physical properties and organic carbon of the cassava field cultivated

Soil test time	Sand	Silt	Clay	Organic carbon
Pre	82.60a	8.73a	8.93a	3.12a
Post	82.60a	8.73a	8.93a	3.06b
LSD(0.05)	2.5	0.96	0.84	0.03
SE	0.87	0.33	0.29	0.01
Cultivars				
TME-419-plots	81.67b	8.00a	9.67b	3.39c
Nwaugo-plots	86.00a	5.00b	9.00bc	2.29e
Give-me-chance-plots	81.33b	9.00a	10.00b	2.38d
Hope-plots	83.33ab	8.00a	8.07c	3.55b
Game changer-plots	80.67b	8.00a	11.23a	3.86a
LSD(0.05)	3.23	1.24	1.08	0.05
SE	1.12	0.43	0.38	0.02
Cultivar x Soil test time	0.00ns	0.00ns	0.00ns	0.03*

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences, SE: Standard error

Table 6: Micro elements identified in the different cassava cultivar's field cultivated

Soil test time	Manganese	Iron	Copper	Zinc
Pre	57.23a	94.71a	1.44a	3.51a
Post	55.16b	89.17b	1.35b	2.91b
LSD(0.05)	1.99	1.11	0.03	0.16
SE	0.69	0.38	0.01	0.06
Cultivars				
TME-419-plots	45.01d	83.70d	1.20b	3.84a
Nwaugo-plots	57.78b	90.50b	1.52a	3.04c
Give-me-chance-plots	56.68b	86.64c	1.28d	3.29b
Hope-plots	53.00c	91.44b	1.49a	2.66d
Game changer-plots	66.77a	104.47a	1.34c	2.85cd
LSD(0.05)	2.58	1.43	0.03	0.21
SE	0.89	0.49	0.01	0.07
Cultivar x Soil test time	19.69ns	71.26*	0.03*	0.16ns

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences, SE: Standard error

Table 7: Macro elements identified in the different cassava cultivar's field cultivated

Soil test time	Nitrogen	Phosphorus	Calcium	Magnesium	Potassium	Sodium
Pre	0.35a	17.38a	2.90a	1.21a	0.41a	0.25a
Post	0.32b	16.83b	2.84b	1.18b	0.38b	0.25a
LSD(0.05)	0.02	0.49	0.04	0.02	0.02	0.01
SE	0.01	0.17	0.01	0.01	0.01	0.004
Cultivars						
TME-419-plots	0.35b	11.76d	3.37a	1.33a	0.52a	0.24b
Nwaugo-plots	0.26c	13.18c	2.75c	1.17c	0.37c	0.25b
Give-me-chance-plots	0.24c	12.94c	2.39e	1.24b	0.44b	0.25b
Hope-plots	0.36b	27.75a	3.15b	1.19c	0.32d	0.21c
Game changer-plots	0.46a	19.89b	2.69d	1.05d	0.34c	0.31a
LSD(0.05)	0.04	0.64	0.05	0.03	0.03	0.02
SE	0.01	0.22	0.02	0.01	0.01	0.01
Cultivar x Soil test time	0.001ns	5.89*	0.03*	0.004ns	0.001ns	0.0004ns

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences, SE: Standard error

Table 8 showed that there were no significant differences between the pre and post soil status on the pH, exchangeable acidity, exchangeable hydrogen, and exchangeable aluminum, while the exchangeable cation content of the pre soil sample (131.80±0.98) was significantly higher than the post soil samples with 119.67±0.98. The pH value of the Hope grown plot (6.53±0.07) was significantly higher than the rest cultivar specific grown plots, while the highest exchangeable cation was observed in the Game changer grown plot (179.22±1.27). However, the TME-419 grown plot had the highest exchangeable acidity (0.52±0.02) that was significantly higher than the Hope and Game changer grown plots. Also, the exchangeable hydrogen of TME-419 grown plot (0.52±0.01) was significantly higher than the Give-me-chance and Game changer grown plots, respectively. The interaction between the cultivars and the time of soil testing was significant for the exchangeable cation.

The changes in macronutrients as a result of cassava growth and yield showed that the changes in nitrogen ranges from -0.11 (Give-me-chance plots) to 0.11 (Game changer plots), phosphorus ranges from -5.62 (TME-419) to 10.37 (Hope plots), calcium ranges from -0.51 (Give-me-chance) to 0.47 (TME-419), magnesium ranges from -0.16 (Game changer) to 012 (TME-419), while potassium ranges from -0.06 (Hope plots) to 0.14 (TME-419 plots) (Table 9).

The changes in micro-nutrients and organic carbon showed that magnesium ranges from -12.22 (TME-419) to 9.54 (Game changer plots), iron ranges from -11.01 (TME-419 plots) to 10.30 (Game changer plots), copper ranges from -0.24 (TME-419 plots) to 0.08 (Nwaugo plots), zinc content ranges from -0.85 (Hope plots) to 0.33 (TME-419 plots), while the changes in organic carbon content ranges from -0.83 (Nwaugo plots) to 0.74 (Game changer plots) (Table 10).

Table 8: Soil vitals as influenced by the cultivation of cassava cultivars

Soil test time	pH	EC	EA	EH	Exch Aluminium
Pre	6.03a	131.80a	0.46a	0.47a	0.02a
Post	6.01a	119.67b	0.47a	0.47a	0.02a
LSD(0.05)	0.16	2.84	0.03	0.03	0.01
SE	0.05	0.98	0.01	0.01	0.004
Cultivars					
TME-419-plots	5.86c	120.56c	0.52a	0.52a	0.02a
Nwaugo-plots	6.25b	90.33d	0.49ab	0.49ab	0.01a
Give-me-chance-plots	5.91c	141.67b	0.48ab	0.45b	0.01a
Hope-plots	6.53a	86.78d	0.47b	0.48ab	0.02a
Game changer-plots	5.72c	179.22a	0.41c	0.41c	0.02a
LSD(0.05)	0.2	3.66	0.04	0.04	0.01
SE	0.07	1.27	0.02	0.01	0.01
Cultivar x Soil test time	0.12ns	284.14*	0.003ns	0.001ns	0.0003ns

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences, SE: Standard error, EC: Electrical conductivity, EA: Exchangeable acidity, EH: Exchangeable hydrogen

Table 9: Changes in soil macronutrients as influenced by cultivation of different cassava varieties

Plots	Nitrogen	Phosphorus	Calcium	Magnessium	Potassium
TME-419-plots	0	-5.62	0.47	0.12	0.14
Nwaugo-plots	-0.09	-4.2	-0.15	-0.04	-0.01
Give-me-chance-plots	-0.11	-4.44	-0.51	0.03	0.06
Hope-plots	0.01	10.37	0.25	-0.02	-0.06
Game changer-plots	0.11	2.51	0.21	-0.16	-0.04

Table 10: Changes in soil micronutrients and organic carbon as influenced by cultivation of different cassava varieties

Plots	Manganese	Iron	Copper	Zinc	Organic carbon
TME-419-plots	-12.22	-11.01	-0.24	0.33	0.27
Nwaugo-plots	0.55	-4.21	0.08	-0.47	-0.83
Give-me-chance-plots	-0.55	-8.07	-0.16	-0.22	-0.74
Hope-plots	-4.23	-3.27	0.05	-0.85	0.43
Game changer-plots	9.54	10.3	-0.1	-0.66	0.74

Discussion

Cassava (*Manihot esculenta* Crantz) shows substantial genotypic variability in growth habit, root bulking dynamics and nutrient demand. Newer released varieties are often bred for higher yield potential, disease resistance and sometimes improved nutrient-use efficiency; however, their realized performance depends strongly on site-specific soil fertility, management (especially fertilizer type and timing), and prior cropping history. In this study, there were gradual growth of all the cassava varieties considered and there were varietal differences in the agronomic parameters considered of which the local cultivated variety (Give-me-chance) produced the tallest plants and the leaf production as against the newly released varieties.

However, the recently improved and released variety (Hope) produced larger leaves as against the locally sourced varieties which has been cultivated by the local farmers for long, which supports the findings of Wahyuningsih and Sutrisno (2019) [15]. Thus, the newly released varieties has a higher chance of photosynthetic activities.

The production of taller cassava stems by the local varieties as against the recently improved varieties had earlier been reported by Ossai *et al*. (2025) [11] who highlighted the short stem size of the newly improved cassava varieties as a constraint to the rapid multiplication of the varieties for ease of dissemination to the end users within the shortest possible time, thus recommending the utilization of technologies like the semi autotrophic hydroponics (SAH) for quick dissemination. However, the improved varieties in this study has shown an improved leaf area formation relative to the local best, thus encouraging more space for photosynthetic activities which could be partitioned to the root bulking Bararyenya *et al*. (2019) [4] has reported a similar findings to this study.

This finding validates the aim of the breeders who developed the improved varieties bearing in mind the need to improve the yield potential of the local varieties which has been cultivated for a long time, and also improve the income generation ability of the subsistence and commercial cassava producers to meet industrial and food needs. This was shown in the low number of tuber yield and weight of tubers harvested in the local cultivated varieties. This finding supports the report of Ossai *et al*. (2025) [11] who reported that despite the low multiplication rate of the stem propagule of the improved varieties, the yield far outweighs the local varieties as it could be that the breeders' goal was majorly to improve the yield index as against multiplication.

Cassava has been reported to thrive well in a marginal to rich soil which allows farmers to cultivate cassava in virtually all arable lands, however, yield potentials is higher in a well-balanced soil, necessitating the need to conduct critical soil nutrient search to ascertain the required nutrient deficiency for adequate augmentation with either synthetic or organic sources of the nutrient. This was observed in the findings of the pre and post soil status where most elements hitherto high in the pre soil status depreciated as a result of the nutrient assimilation by the cassava varieties. However, some of the elements in the post status were higher than they were initial found in the pre soil status. (Biratu *et al.,* 2019) [6]. This showed that the due to the deep feeding habit of cassava, some proportions of the elements might have been taken up/absorbed/assimilated by the cassava varieties for its growth and development and eventual yield through bulking.

In this study, all the varietal specific plots retained their sandy loam textural class despite the cassava cultivation. However, the organic matter contents of the recently improved cassava varieties grown plots were higher than the old varieties as there were less depreciation of the organic matter contents of the soil. This is important in the balance of other macro and micro nutrients in the soil. The Game changer grown plots had the highest amount of manganese, iron, and nitrogen, while the iron and phosphorus contents were highest in the Hope specific grown plots in the post soil status, and the zinc, calcium, magnesium and potassium were highest in the TME-419 grown plots. They were all above the pre soil status of the micro elements. This shows that the varieties contain high amount of the elements inbuilt which were released to the surrounding environment through the leaf droppings which in turn decays after sometimes before the soil was sampled for post analysis (Peng *et al*., 2025) [12]. While in other crops, there were depletion of the elements found in the soil.

In terms of the changes in the macro elements, Hope grown plots and Game changer added nitrogen, phosphorus and calcium to the soil, while the TME-419 varieties added magnesium and potassium to the soil, while the 2 old cultivated varieties takes up the available nutrients from the soil and the decay of their leaf droppings could not amend for the amount taken up from the soil (Kwasi, 2018) [9]. On the other hand, TME-419 takes up all the microelements from the soil except zinc, while Game change adds manganese and iron into the soil but depleted the copper and zinc contents of the soil, whereas Give-me-chance takes up all the micro elements and the organic carbon from the soil leading to the reduction in their contents in the soil. The addition of the microelements into the soil could have led to a positive change in the organic carbon of the soil of the 3 newly released varieties (Aumtong *et al*., 2025) [3]. This findings is an advantage to the farmer in cultivating the newly released varieties in marginal soils as against the old varieties.

Conclusion and Recommendation

The prevalence of cassava cultivation by many subsistence farmers stemming by its ability to thrive in a marginal soil. However, its productivity has been constrained by genotype by environment interaction as the nutrient requirement of different varieties varies. The three newly released (TME-419, Hope and Game changer) varieties outperformed the old varieties in terms of fresh tuber yield. However, the old varieties (Give-me-chance and Nwaugo) produced taller plants which facilitates the dissemination of the old varieties faster than the newly released varieties, an area to be considered in future breeding activities on the newly released varieties. Also, in terms of nutrient changes in the grown areas, the newly released varieties adds nutrient to the soil through the decay of the leaf droppings compensating for the consumed nutrient from the soil as against the old varieties which depletes the nutrients in soil rapidly. Thus it is recommended that the newly released varieties be rapidly multiplied for dissemination using improved technologies like the semi autotrophic hydroponics to end users, and the newly released varieties should be used to gradually replace the old varieties in cultivation to increase cassava productivities as minimal nutrient requirements is needed for their cultivation.

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