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Evaluation of Effect of Mechanized Practice on Growth and Yield of Cassava Varieties Over Conventional Method for College Farm

Abraham Azubuike Ahiakwo[1*] and Ngozi Joy Ojike Alali[1]
Federal College of Educaiion (Tech.) Omoku, Rivers State, Nigera
**Corresponding Author*

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ABSTRACT: **This study evaluated the effect of mechanized practices on the growth and yield of cassava varieties compared to conventional manual methods at the Federal College of Education (Tech.), Omoku farm. Four cassava varieties (TMS 98/0505, TMS 98/0581, TME 419, and TMS 30572) were planted under mechanized and conventional systems using a randomized complete block design with three replications. Growth parameters (height, leaf number, leaf area) and yield components (root length, circumference, number of tubers, and storage root yield) were measured. Results revealed that mechanized practices significantly improved sprouting percentage, plant height, leaf number, and yield across varieties. ANOVA and t-test analyses confirmed that mechanization produced higher yields, with TMS 98/0581 recording the highest yield (29.55 t/ha) under mechanization compared to 25.58 t/ha under conventional practice. Mechanization enhanced efficiency, reduced drudgery, and improved cassava productivity, making it a viable pathway for sustainable agribusiness in college farms**

KEYWORDS: Mechanization, Yield, Growth parameters, Sustainable agribusiness, Conventional farming.

I. INTRODUCTION

Cassava (*Manihot esculenta* Crantz) has historically been the foundation of tropical agriculture, particularly in sub-Saharan Africa, where it transitioned from a subsistence crop to an industrial resource. Rising global demand for food and raw materials has exposed the limitations of traditional manual farming, which is labor-intensive, inefficient, and costly. Scholars argue that reliance on primitive tools restricts productivity, making mechanization essential for sustaining the "Cassava Revolution"[1]. Central to this shift is the adoption of varieties suited to mechanized farming, notably TME 419, which facilitates efficient use of tractors, planters, sprayers, and harvesters compared to older, sprawling types [2].

For smallholder farmers, the inability to afford labor for large acreages perpetuates cycles of low productivity. Mechanization offers a solution by replacing human effort with machine power, enabling expansion without proportional increases in cost. This transformation enhances resource-use efficiency and redefines cassava farming from a survival strategy into a profitable enterprise. In essence, mechanization not only addresses the challenges of drudgery and inefficiency but also positions cassava as a driver of economic growth and industrialization in developing regions[3].

In land preparation, mechanization offer significant advantages over conventional cassava farming methods by improving soil structure, nutrient availability, and crop yield potential. Unlike manual slash-and-burn practices that cause shallow loosening and soil degradation, mechanical tillage with disc ploughs and harrows reduces soil bulk density, increases porosity, and breaks hardpans, creating a deep, friable environment ideal for cassava's root expansion. This allows the crop to channel more energy into starch accumulation rather than root penetration, resulting in larger tubers. Additionally, mechanized ploughing thoroughly mixes organic matter, accelerating nutrient mineralization and ensuring uniform distribution of nitrogen and phosphorus, which supports stronger early growth compared to the uneven nutrient pockets left by manual methods.[3] [4]

Conventional ridging in cassava farming, often done manually, produces uneven mounds that lead to inconsistent moisture retention, nutrient distribution, and plant growth, while also complicating mechanized maintenance. In contrast,

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mechanized ridging offers uniformity and efficiency. [5]demonstrate that mechanical ridges create a larger volume of loose soil acting as a "tuber nursery," enabling cassava variety TME 419 to develop roots in compact clusters that enhance yield and facilitate mechanical harvesting. Standardized ridges at a 1-meter width, further ensure a consistent plant density of 10,000 stands per hectare, a level rarely achieved with manual mound systems

On planting method, [6] investigate the contribution of mechanized planters to crop establishment. It was noted that in manual planting systems, stem cuttings are inserted at inconsistent depths and angles, which increases the risk of rotting when planted too deeply or desiccation when planted too shallowly. Mechanized planters mitigatethese risks by ensuring uniform placement of each cutting at a precise 45-degree angle and consistent depth. This technical precision promotes synchronized sprouting. Large-scale experimental trials revealed sprouting rates of 95–98% under mechanized planting, compared to 70–85% in manually planted plots. The resulting "perfect stand" is the principal factor underpinning the superior yields consistently observed in mechanized fields

On weed control, manual weeding with hoes in conventional farming is slow and often results in "delayed weeding," which stunts cassava growth and permanently reduces yield. [7] highlight that mechanized weed management—combining pre-emergence herbicides with tractor-mounted inter-row cultivators—keeps fields weed-free during this critical growth window and can cover 5–10 hectares in a day, compared to weeks with manual labour. This is particularly crucial for the TME 419 variety, whose upright, narrow canopy delays shading out weeds. Mechanization not only protects the crop's biomass production but also improves soil conditions. [8]Kolawole et al. (2024) emphasize the "aeration effect" of mechanical cultivation, which breaks soil crusts, enhances oxygen flow, and boosts fertilizer efficiency, whereas manual hoeing often compacts soil around the plant base. Thus, mechanized systems provide dual benefits: eliminating weed competition and improving root environment simultaneously.

In addition, manual cassava harvesting often results in significant yield losses, particularly in varieties like TME 419 whose deep-seated roots are prone to breakage, leaving 20–30% of tubers unrecovered in hard soils. [9] demonstrated that mechanical lifters, which employ vibrating blades to elevate the soil-root mass, increased harvestable yield by up to 35% while minimizing damage that accelerates physiological post-harvest deterioration. Beyond yield recovery, mechanized harvesting ensures faster throughput, enabling factories to receive large volumes of fresh roots before spoilage occurs, thereby maximizing starch yield. This paper therefore aims to evaluate the impact of mechanized practices on the growth and yield of cassava varieties (TME 419, TMS 30572, TMS 98/0505, TMS 98/0581) compared to conventional manual methods, with specific application to the transition of college farm operations

II. METHODOLOGY

The experiment was conducted at the Teaching and Research Farm of the Federal College of Education (Tech.), Omoku, Rivers State (latitude 5.3419°N, longitude 6.6558°E). The area experiences annual rainfall above 1000 mm, average temperatures of 28–32°C, and relative humidity of 76%. Composite soil samples were collected at depths of 0–15 cm and 15–30 cm and analyzed for physicochemical properties following standard procedures [4] [7].

A randomized complete block design (RCBD) with three replications was employed. Four cassava varieties—TMS 98/0505, TMS 98/0581, TME 419, and TMS 30572—were obtained from the National Root Crops Research Institute (NRCRI), Umudike. Mechanized plots received ploughing, harrowing, and ridging, while conventional plots were prepared manually using hoes. Planting was done in March 2025 with 25 cm stem cuttings inclined at 45° on ridges (mechanized) and mounds (conventional). Manual weeding was conducted twice, followed by slashing at 7–8 months after planting. Harvesting was carried out at 12 months.

Growth parameters (height, leaf number, leaf area) and yield components (root length, circumference, number of tubers, and storage root yield) were measured. Data of all growth and yield components were analyzed using analysis of variance and t-test at 5% probability level.

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III RESULT AND DISCUSSION

Physical and chemical properties of the soil obtained from the experimental areashow that the soil in terms of the mineral content and composition-sandy loam is ideal for cassava farming on a large scale. Though acidic (pH 5.5), with fair good organic matter (2.80%)andlow nitrogen (0.10%), fertility is modest, meaning cassava performance is strongly enhanced by mechanized practice of tillage.

Higher establishment percentage was recorded (Table 3). The result showed no significant differences (P≤0.05) of establishment percentage across the cassava genotypes. Sprouting was excellent across varieties (>93%). TME419 had perfect sprouting (100%) under mechanized tillage.Mechanized tillage generally improved sprouting compared to conventional. TME 419 variety was the tallest plant in all the sampled months with erect stems ideal for mechanize input whereas TMS 98/0581 was the shortest variety. Mechanized tillage gave a growth edge for most varieties over conventional tillage

The result showed significant differences (P≤0.05) among the cassava genotype in terms of number of leaves per plant within the experimental time interval (Table 4). TME 419 had the least number of leaves per plant; Significant differences (P≤0.05) were observed among the cassava genotypes for leaf area (Table 5). There is a general increase in leaf area of all the cassava genotypes evaluated from 3 MAP to 6 MAP and a decline from 9 MAP. In all the cassava genotype evaluated, TMS 98/0581 had the largest leaf area for all the months under investigations, while TMS 98/0505 had the least leaf area in all the months under investigation. Number of cassava tubers per plants varied significantly (Table 6). The result showed that TIMS98/0581 produced significant highest number of storage roots per plants, followed by TMS 98/0581 whereas TMS 30572 had lowest number of storage root per plants. Length of tubers per plant differed significantly (P≤0.05) among the cassava genotype sampled. TMS 98/0581 had significant longest tubers, TMS 30572 recorded the shortest storage root; The result showed the circumference of tubers differed significantly among the cassava genotypes (P≤0.05). Fresh storage root yield considered for both conventional and mechanized plot, showed that TMS 98/0581 recorded the highest fresh storage root yield (Fig. 1) followed by TME 419 while the lowest fresh storage root yield was recorded for TMS 30572.

Mechanized tillage significantly enhanced cassava performance across all growth stages. TME419 recorded the highest sprouting (100 %) and tallest plants (212.87 cm), while TIMS98/0581 achieved the largest leaf area (193.19 cm^2) and highest yield (29.55 t/ha). These findings indicate that mechanization improved soil physical conditions, leading to better root establishment and nutrient uptake.

The ANOVA results confirmed that tillage method had a significant effect on growth and yield parameters ($p < 0.05$). The t-test further showed that mechanized plots consistently outperformed conventional plots in plant height, leaf number, and yield. This agrees with [10],[11} who reported that mechanized tillage increased cassava yield by improving soil aeration and root penetration, improving root bulking and reducing plant stress.

Mechanization improves soil porosity, moisture retention, and nutrient accessibility,which are critical in sandy loam soils like those in this study (pH 5.5, organic matter 2.80 %). The higher leaf number and area under mechanized plots suggest greater photosynthetic efficiency, translating into higher carbohydrate accumulation in storage roots. In agreement with [12] this greater photosynthetic efficiency give rise to higher cassava yield under mechanize tillage than under no-tillage systems

The yield advantage of 3–5 t/ha under mechanized tillage is agronomically and economically significant. It demonstrates that mechanization can offset the limitations of low-fertility soils by improving root development and nutrient uptake efficiency.

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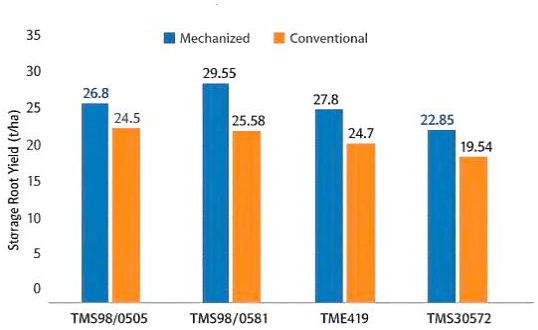

Figure 1: Comparison of storage root yield mechanize vs conventional

Table 3: Average height of varieties

Cassava varieties	Months after planting					
	Mechanize tillage			Conventional		
	3	6	9	3	6	9
TMS98/0505	60.21	192.90	161.40	58.31	182.50	151.46
TIMS98/0581	53.04	86.42	122.30	50.24	82.40	112.30
TMS30572	57.67	104.04	135.50	53.67	98.04	123.40
TME419	97.10	176.43	212.87	86.12	170.34	200.53

Table 4: Average number of leaves per stand

Cassava varieties	Months after planting					
	Mechanize tillage			Conventional		
	3	6	9	3	6	9
TMS98/0505	80.50	258.30	285.06	70.30	247.40	265.76
TIMS98/0581	78.60	208.36	202.40	71.40	198.86	190.60
TME419	71.55	129.08	188.41	60.54	121.08	180.65
TMS30572	52.13	192.30	215.22	48.33	181.20	203.12

Table 5: Measured Leaf Area of Varieties

Cassava varieties	Months after planting					
	Mechanize tillage			Conventional		
	3	6	9	3	6	9
TMS98/0505	117.65	124.62	122.60	116.65	125.60	121.60

TIMS98/0581	180.10	193.19	188.10	183.10	189.10	187.10
TME419	178.21	189.09	185.25	177.20	186.09	184.35
TMS30572	112.50	116.t7	109.80	114.50	117.26	110.60

Table 6: Yield and yield components of cassava varieties

Cassava Varieties	Mechanized				Conventional			
	No. of storage root/plant	Root lengthc(m)	Circumfrn cof storageroot	Storage root yield(t/ha)	N0 of storageroot/plant	Root length(cm)	Circumfrn cof storage root	Storage Root yield(t/ha)
TMS98/0505	5.72	29.80	15.88	26.80	4.61	31.10	15.28	24.50
TIMS98/0581	7.60	44.80	23.34	29.55	6.87	43.23	21.34	25.58
TMS30572	4.65	32.81	16.87	27.80	4.88	32.10	15.50	24.70
TME419	6.60	45.23	21.47	22.85	7.10	44.13	22.	19.54

IV CONCLUSION

Mechanized tillage significantly improved cassava growth and yield compared to conventional practices.It enhanced sprouting, height, leaf number, and leaf area. It also increased storage root yield by 10–20 %, with*TIMS98/0581* indicating highest yield under mechanized tillage (29.55 t/ha). Mechanized tillage optimizes soil structure and root development, leading to superior cassava productivity in sandy loam soils. Its adoption is recommended for sustainable cassava production in the college farm, balancing initial mechanization costs with long-term yield gains.

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