Field Performance and Susceptibility Patterns of Ten Cassava Varieties to Mosaic Virus Disease Under Natural Infection Pressure in the Sudan Savannah, Nigeria

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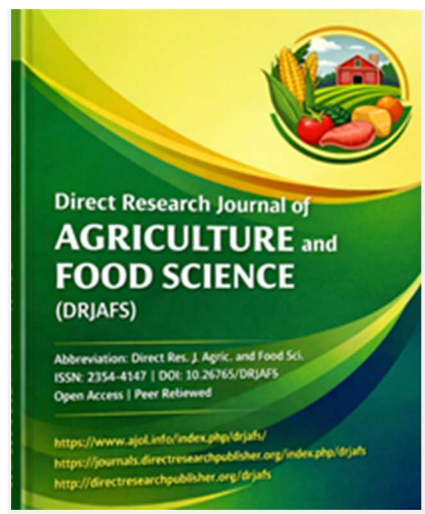
ABSTRACT

Cassava mosaic disease (CMD) is the foremost viral threat to cassava production across sub-Saharan Africa, but data on varietal performance under natural infection in Nigeria's Sudan Savannah remain scarce. This study, conducted during the 2024 rainy season at Abdullahi Fodiyo University, Kebbi State, evaluated ten improved varieties and two local landraces for their responses to natural CMD. Using a randomized complete block design with three replicates and infector rows of susceptible 'Sarkin Fawa' to boost inoculum pressure, disease incidence and severity were recorded bi-weekly from 2 to 12 weeks after planting (WAP) on a 1–5 scale. Results showed significant differences (P < 0.05) among varieties. The local landrace DANGWAMNATI proved most susceptible, with incidence rising from 28.57% at 2 WAP to 100% by 10 WAP and severity reaching 63.10% at 12 WAP. BAHAUSHE also displayed high susceptibility (95.24% incidence, 60.71% severity). IBA 961632 showed moderate susceptibility (47.62% incidence, 23.81% severity), while IBA 30572 exhibited partial resistance (33.33% incidence, 14.29% severity). Remarkably, six improved varieties (OBASANJO 2, GAME CHANGER, BABA 70, IBA 0505, IBA 164773, and IBA 154810) recorded zero incidence and severity throughout the trial, indicating complete field resistance consistent with CMD2 gene-mediated immunity. Symptoms in susceptible types included mosaic, chlorosis, distortion, and stunting. This work establishes clear susceptibility categories for cassava varieties under natural CMD infection in the Sudan Savannah and identifies six immune genotypes suitable for further validation and immediate promotion to farmers. The ongoing reliance on highly susceptible local landraces poses a serious risk to regional production, highlighting the critical need for accelerated replacement with improved, resistant varieties.

Keywords: *CMD, Resistance, Incidence, Severity, Cassava, Sudan savannah, whitefly, Bemisia tabaci*



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INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a vital root crop in sub-Saharan Africa, serving as a primary food source for over 500 million people (FAOSTAT, 2023). Nigeria, the largest global producer, contributes about 60–65 million tonnes annually, roughly 18–20% of worldwide production (FAOSTAT, 2023). Its drought resilience, ability to grow in poor soils, and flexible harvesting make cassava especially important in semi-arid areas like Nigeria's Sudan Savannah, where erratic rainfall limits other staples (El-Sharkawy, 2004). In this region, cassava provides dietary carbohydrates and serves as raw material for industrial uses (Adebayo & Silberberger, 2020). Despite its significance, production is severely threatened by Cassava Mosaic Disease (CMD), the most economically damaging viral disease across Africa (Legg *et al.*, 2015). CMD is caused by cassava mosaic begomoviruses (CMBs), including ACMV and EACMV, transmitted by whitefly *Bemisia tabaci* and infected stem cuttings (Fauquet *et al.*, 2008; Legg *et al.*, 2011). Symptoms include mosaic patterns, chlorosis, distortion, stunting, and reduced photosynthesis, causing yield losses up to 90% in susceptible varieties (Hahn *et al.*, 1980). The Sudan Savannah's high temperatures (28–42°C) and distinct rainy season favor whitefly proliferation, complicating CMD management (Sowunmi, 2020; Eni *et al.*, 2018). Recent research identified multiple begomovirus species in West Africa, including virulent EACMV-UG strains posing new threats (Combala *et al.*, 2024; Saffa *et al.*, 2025). Farmers largely cultivate local landraces not systematically evaluated for CMD resistance. Although improved varieties from IITA and NRCRI exist, their performance under local conditions remains under-documented (Ogbe *et al.*, 2003; Ariyo *et al.*, 2005). Adoption is limited by low awareness, restricted clean planting material access, and preferences for local culinary qualities (Manyong *et al.*, 2000).

Field evaluations are crucial for location-specific recommendations, complementing controlled studies (Egesi *et al.*, 2007). The specific objectives of this study were: (1) to evaluate the field responses of ten cassava varieties (eight improved and two local landraces) to natural CMD infection in the Sudan Savannah; (2) to monitor disease progression over a 12-week period and establish susceptibility categories; and (3) to inform evidence-based variety recommendations for farmers in Kebbi State.

MATERIALS AND METHODS

Study Area

The field study was carried out at the Teaching and Research Farm of Abdullahi Fodiyo University of Science and Technology, Aliero (AFUSTA), Kebbi State, Nigeria, during the 2024 rainy season (June to October). Situated in the Sudan Savannah agro-ecological zone at latitude 12°18'16.9"N and longitude 4°29'56.9"E, the site experiences an average annual rainfall of 690 mm mainly between June and September, with temperatures ranging from 28°C to 42°C (Eteng *et al.*, 2025). The vegetation is dominated by grasses and short trees, and the sandy loam soils are typical for the region. This location has a history of cassava cultivation and naturally occurring whitefly (*Bemisia tabaci*) populations that act as vectors for cassava mosaic viruses.

Plant Materials

Ten cassava varieties were evaluated, including eight improved genotypes sourced from the International Institute of Tropical Agriculture (IITA), Ibadan—namely IBA 30572, OBASANJO 2, GAME CHANGER, IBA 164773, IBA 154810, IBA 961632, BABA 70, and IBA 0505—and two farmer-preferred local landraces from Aliero: DANGWAMNATI and BAHAUSHE. The highly susceptible local variety SARKIN FAWA was planted as infector rows to enhance disease inoculum pressure across the experimental plots. All improved varieties were obtained as virus-free stem cuttings from certified mother plants at IITA, while local landraces were visually inspected to confirm absence of CMD symptoms before planting. Stem cuttings approximately 15 cm long with 5–6 viable buds were prepared for planting.

Experimental Design and Field Layout

The experiment employed a Randomized Complete Block Design (RCBD) with three replicates. Each replicate consisted of seven plants per variety spaced at 1m × 1m, totaling 21 plants per variety across all replicates. Replicate plots measured 10m × 10m with 1.5m pathways between them to facilitate access and minimize interference. To ensure uniform disease pressure, border and inter-rows of the susceptible SARKIN FAWA variety were established two weeks prior to planting test varieties; these infector rows surrounded each replicate plot and were interspersed among test rows to maximize whitefly-mediated virus transmission.

Crop Management

Standard agronomic practices suitable for cassava production in the Sudan Savannah were followed throughout the growing season. Manual planting coincided with the onset of rains in June 2024. Weeding was conducted manually at four, eight, and twelve weeks after planting (WAP) to maintain weed-free conditions. No chemical insecticides or fertilizers were applied to avoid disrupting natural whitefly populations or disease development. The crop was grown under rain-fed conditions without supplemental irrigation.

Disease Assessment

Disease assessments occurred biweekly from two to twelve WAP (at weeks 2, 4, 6, 8, 10, and 12). All plants within each plot were visually inspected for typical CMD symptoms such as leaf mosaic patterns, chlorosis, distortion, vein clearing, and stunting. Disease incidence was calculated as the percentage of symptomatic plants per plot using standard formulas (Chaube & Pundhir, 2005).

$$\textbf{DI (\%)} = \frac{number\ of\ diseased\ plants}{total\ number\ of\ plants\ examined} \times 100$$

Disease severity index (DSI) was rated on a scale from one (no symptoms) to five (very severe symptoms including leaf distortion and plant stunting) following protocols established by IITA (1990).

$$\textbf{DSI} = \frac{[\textbf{Sum (class frequency} \times \textbf{score of rating class)}]}{(\textbf{Number of plants assessed} \times \textbf{Maximum scale})} \times 100$$

Symptom Documentation

Representative symptomatic and healthy plants were photographed at twelve WAP under natural light between 9:00 and 11:00 am for symptom documentation. Images captured symptom expression in susceptible varieties (DANGWAMNATI, BAHAUSHE, IBA 961632), partially resistant types (IBA 30572), and resistant genotypes showing no symptoms (OBASANJO 2, GAME CHANGER, BABA 70, IBA 0505, IBA164773, IBA154810).
Data on disease incidence and severity underwent analysis of variance (ANOVA) using SAS version 9.4 software. Percentage data were arcsine-transformed prior to analysis to satisfy normality assumptions; however, untransformed means are presented for clarity. Duncan's Multiple Range Test (DMRT) at P <0.05 was used to separate means and identify significant differences among varieties at each assessment time point. Standard errors accompanied all means to indicate variability within treatments.

Statistical Analysis

Data collected on disease incidence and severity were subjected to analysis of variance (ANOVA) using SAS Institute (2013) software. Percentage data were arcsine-transformed prior to analysis to satisfy normality assumptions; however, untransformed means are presented for clarity. Homogeneity of variance was tested prior to ANOVA. Given the zero-variance groups among resistant varieties, generalized linear models (GLM) with binomial errors were considered a suitable alternative, though arcsine-transformed ANOVA is reported here as the standard approach in this literature. Means were separated using Duncan's Multiple Range Test (DMRT) at P < 0.05 to identify statistically significant differences among varieties at each assessment period. Standard errors (SE) were calculated for all means to indicate variability within treatments.

RESULTS

Symptom Expression Under Field Conditions

During the field evaluation, cassava varieties exhibited characteristic symptoms of cassava mosaic virus infection, with symptom expression varying markedly among varieties and over time. The most prevalent symptom was leaf mottling and mosaic patterns, appearing as light green to yellow patches interspersed with normal green tissue on leaf laminae. These patterns ranged from mild chlorotic blotches in moderately susceptible varieties to severe, coalescing chlorotic patches covering most of the leaf surface in highly susceptible varieties. Leaf distortion was frequently observed in infected plants, including leaf curling, wrinkling, and significant reduction in leaf size. In severely affected plants of DANGWAMNATI and BAHAUSHE at 10-12 WAP, leaves exhibited filiform or "shoestring" appearance, with narrow, strap-like leaf blades. Chlorosis was common, manifesting as generalized yellowing of leaves either uniformly or in diffused patterns, often accompanied by chlorotic mottling along the veins (vein clearing). Stunting was a key observation in susceptible varieties, with infected plants showing markedly reduced stature, shortened internodes, and overall poor vigor compared to healthy plants of the same age.

Figure 1 shows a representative plant of the susceptible local landrace DANGWAMNATI exhibiting severe mosaic symptoms, extensive chlorosis, and leaf distortion at 10 WAP. Figure 2 shows a healthy plant of the resistant variety OBASANJO 2 at the same growth stage, demonstrating normal leaf development, dark green coloration, and vigorous growth with no visible symptoms.

Figure 1: Mosaic symptom on susceptible cassava plant (DANGWAMNATI) at 10 WAP showing severe chlorotic patches, leaf distortion, and stunting

Figure 2: Healthy cassava plant (OBASANJO 2) at 10 WAP showing normal leaf development and no disease symptoms

Disease Incidence Under Field Conditions

The percentage of Cassava mosaic disease incidence for the ten varieties at 2 to 12 weeks after planting (WAP) revealed statistically significant differences ($P < 0.05$) among varieties at each evaluation period, allowing clear delineation of susceptibility categories (Table 1).

Table 1: CMD Incidence (%) During Field Trial at AFUSTA, 2024 Rainy Season

Variety	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
DANGWAMNATI	28.57a	47.62a	52.38a	66.67a	100.00a	100.00a
BAHAUSHE	14.29b	28.57b	42.86b	57.14b	90.47b	95.24b
IBA 961632	4.76c	19.05c	28.57c	33.33c	42.86c	47.62c
IBA 30572	0.00d	4.76d	9.52d	19.05d	23.81d	33.33d
OBASANJO 2	0.00d	0.00e	0.00e	0.00e	0.00e	0.00e
GAME CHANGER	0.00d	0.00e	0.00e	0.00e	0.00e	0.00e
BABA 70	0.00d	0.00e	0.00e	0.00e	0.00e	0.00e
IBA 0505	0.00d	0.00e	0.00e	0.00e	0.00e	0.00e
IBA 164773	0.00d	0.00e	0.00e	0.00e	0.00e	0.00e
IBA 154810	0.00d	0.00e	0.00e	0.00e	0.00e	0.00e
SE ±	1.92	2.36	2.36	2.58	2.36	1.46

Means followed by the same letter within columns are not significantly different at P < 0.05 (DMRT)

Susceptible Varieties

The local landrace DANGWAMNATI consistently recorded the highest disease incidence means at every evaluation period throughout the trial. Disease incidence in this variety began at 28.57% at 2 WAP, increased progressively to 47.62% at 4 WAP, 52.38% at 6 WAP, 66.67% at 8 WAP, and reached 100% by 10 WAP, which was maintained through 12 WAP.

BAHAUSHE, the second local landrace, formed the next distinct statistical group with means ranging from 14.29% at 2 WAP to 95.24% at 12 WAP. Although this variety showed slightly delayed disease development compared to DANGWAMNATI, with incidence of 90.47% at 10 WAP compared to 100% for DANGWAMNATI, it still exhibited very high susceptibility with near-complete infection by the end of the season.

IBA 961632 demonstrated moderate susceptibility, with disease incidence increasing progressively from 4.76% at 2 WAP to 47.62% at 12 WAP. The mean incidence for this variety was statistically lower than both local landraces at every assessment stage, placing it in a distinct intermediate category.

Partially Resistant Variety

IBA 30572 showed partial resistance, with disease incidence starting at 0% at 2 WAP and reaching only 33.33% by 12 WAP. This was significantly lower than IBA 961632 and the local landraces at all assessment points, indicating a moderate level of field resistance that limited but did not completely prevent infection.

Highly Resistant Varieties

A large group of six improved varieties OBASANJO 2, GAME CHANGER, BABA 70, IBA 0505, IBA 164773, and IBA 154810—maintained a mean disease incidence of 0.00% throughout the entire 12-week duration of the trial. The DMRT test placed all these varieties in the same homogenous group at every time point after 2 WAP, indicating no statistical evidence to differentiate their resistance levels from one another. These varieties demonstrated complete and superior field resistance under the natural infection conditions of this trial, with no visible symptoms observed in any plant at any assessment period.

Disease Severity Under Field Conditions

Disease severity, which measures the intensity of symptom expression on infected plants, followed patterns consistent with incidence data and provided additional discrimination among varieties (Table 2). Severity scores reflect not only whether plants became infected but also how severely they were affected.

Table 2: CMD Severity (%) During Field Trial at AFUSTA, 2024 Rainy Season

Variety	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
DANGWAMNATI	7.14a	14.29a	21.29a	29.76a	50.00a	63.10a
BAHAUSHE	3.57b	8.28b	15.48b	25.00b	47.62a	60.71a
IBA 961632	1.19c	5.95c	11.90c	15.48c	20.24b	23.81b
IBA 30572	0.00c	1.19d	2.38d	5.95d	9.52c	14.29c
OBASANJO 2	0.00c	0.00d	0.00e	0.00e	0.00d	0.00d
GAME CHANGER	0.00c	0.00d	0.00e	0.00e	0.00d	0.00d
BABA 70	0.00c	0.00d	0.00e	0.00e	0.00d	0.00d
IBA 0505	0.00c	0.00d	0.00e	0.00e	0.00d	0.00d
IBA 164773	0.00c	0.00d	0.00e	0.00e	0.00d	0.00d
IBA 154810	0.00c	0.00d	0.00e	0.00e	0.00d	0.00d
SE ±	0.69	0.46	0.56	0.86	1.03	1.18

Means followed by the same letter within columns are not significantly different at P < 0.05 (DMRT)

Highly Susceptible Varieties

DANGWAMNATI exhibited the highest severity scores throughout the trial, with means increasing from 7.14% at 2 WAP to 63.10% at 12 WAP. The severity progression was steep and consistent, indicating not only high infection rates but also severe symptom development in infected plants. BAHAUSHE demonstrated high susceptibility with means ranging from 3.57% at 2 WAP to 60.71% at 12 WAP. Notably, by 10 WAP, the severity of BAHAUSHE (47.62%) was no longer statistically different from DANGWAMNATI (50.00%), indicating that while BAHAUSHE exhibited slightly less severe symptoms initially, it eventually reached comparable levels of disease intensity by the end of the season.

Moderately Susceptible Variety

IBA 961632 occupied a clear middle ground, with mean severity increasing from 1.19% at 2 WAP to 23.81% by 12 WAP. From 8 WAP onward, its severity was significantly lower than both local landraces but higher than all other improved varieties, confirming its intermediate susceptibility status.

Partially Resistant Variety

IBA 30572 showed a higher level of resistance with mean severity ranging from 0.00% at 2 WAP to 14.29% at 12 WAP. Although low, these means were statistically higher than the most resistant varieties at some assessment points, indicating a low but consistent level of symptom expression in the plants that became infected.

Highly Resistant Varieties

The same six varieties that showed zero incidence—OBASANJO 2, GAME CHANGER, BABA 70, IBA 0505, IBA 164773, and IBA 154810—maintained a mean disease severity of 0.00% throughout the entire 12-week period. The DMRT test consistently placed all these varieties in the same homogenous group, and there was no statistical evidence to differentiate their resistance from one another. These varieties effectively suppressed CMD symptom development to non-detectable levels under the natural field conditions of this trial, demonstrating complete field resistance.

Temporal Patterns of Disease Development

The progression of disease incidence and severity over time revealed distinct patterns characteristic of each susceptibility category. The highly susceptible local landraces showed early disease onset (by 2 WAP), rapid progression, and achievement of maximum incidence and severity by 10-12 WAP. The moderately susceptible IBA 961632 showed later onset and slower progression but continued to accumulate infections throughout the season. The partially resistant IBA 30572 showed very limited disease development, with incidence and severity remaining low even at 12 WAP. The highly resistant varieties showed no disease development at any time point, indicating complete field resistance under the conditions of this trial.

DISCUSSION

The field evaluation at Abdullahi Fodiyo University of Science and Technology, Aliero, provides critical insights into the performance of ten cassava varieties under natural CMD infection pressure in Nigeria's Sudan Savannah. The results reveal a clear resistance hierarchy, from complete field immunity in six improved varieties to extreme susceptibility in local landraces, with significant implications for variety recommendation and food security.

Complete Field Resistance in Improved Varieties

The most striking finding is that six improved varieties OBASANJO 2, GAME CHANGER, BABA 70, IBA 0505, IBA 164773, and IBA 154810—maintained zero disease incidence and zero severity throughout the 12-week assessment. This complete absence of symptoms under natural infection pressure, with infector rows of susceptible Sarkin Fawa ensuring high inoculum availability, provides compelling evidence of robust field resistance. This performance is consistent with the dominant CMD2 resistance gene reported elsewhere, which confers high-level protection by hindering viral replication and systemic movement (Fondong, 2017; Sheat & Winter, 2023). However, because no molecular marker screening or genotyping was performed on these varieties in the present study, this attribution is presented as a hypothesis supported by literature precedent rather than a directly demonstrated mechanism in this trial.

The stability of this resistance in the Sudan Savannah is particularly significant. This environment features high temperatures (28–42°C), distinct rainy seasons, and conditions conducive to whitefly proliferation, all of which could influence resistance expression (Eni et al., 2018). That these varieties maintained complete resistance confirms successful introgression and stable expression of CMD2-mediated resistance in agronomically superior backgrounds, aligning with studies from other West African locations (Olasanmi *et al*., 2021).

OBASANJO 2 (TME 419) is widely documented as a CMD2 carrier with broad adaptation (Olasanmi et al., 2021). GAME CHANGER has shown similar resistance profiles in multi-location trials (IITA, 2025). BABA 70 and the IBA-bred lines carry the same resistance locus and have demonstrated field stability in diverse environments (Ntui *et al*., 2024). Their confirmed immunity in the Sudan Savannah validates their deployment in this important cassava-producing region.

Extreme Susceptibility of Local Landraces

In stark contrast, the local landraces DANGWAMNATI and BAHAUSHE exhibited extreme susceptibility, with DANGWAMNATI reaching full incidence by 10 WAP and BAHAUSHE achieving nearly complete incidence by 12 WAP, accompanied by severe symptom expression. This very high susceptibility is consistent with the absence of functional resistance genes, reflecting the vulnerability of traditional landraces that have not undergone systematic breeding (Combala *et al*., 2024).

The rapid disease progression of symptoms appearing as early as 2 WAP and escalating quickly has important epidemiological implications. Infected plants can act as reservoirs of inoculum, amplifying disease pressure that threatens neighboring fields (Legg *et al*., 2015; Thresh & Cooter, 2005). The severe symptom expression observed would be expected to lead to significant yield losses, as previous studies have documented reductions of up to 90% in highly susceptible varieties (Hahn *et al*., 1980; Legg *et al*., 2015). It should be noted that yield was not directly measured in this trial; these yield-loss statements are drawn from the cited literature and represent projections based on symptom severity, not measured outcomes of the present study.

Continued cultivation of such susceptible landraces represents a significant risk to regional production. Farmers' preferences based on culinary qualities must be balanced against disease-induced losses. Similar situations are documented across West Africa, where traditional varieties persist despite improved resistant options (Manyong *et al*., 2000). This study provides empirical evidence from the Sudan Savannah to inform extension messaging and replacement programs.

Moderate Susceptibility and Partial Resistance

IBA 961632 exhibited moderate susceptibility, with nearly half of plants showing incidence and approximately one-quarter showing severity at 12 WAP. This intermediate performance suggests partial resistance mechanisms, possibly involving polygenic sources such as the CMD1 gene from *Manihot glaziovii*, which confers quantitative resistance through multiple minor genes (Fondong, 2017). However, continued disease progression—incidence rising from very low levels at 2 WAP to nearly half by 12 WAP—indicates incomplete resistance vulnerable to breakdown under high disease pressure or more virulent strains.

IBA 30572, with one-third incidence and lower severity, represents a higher level of partial resistance. The relatively low severity despite moderate incidence suggests tolerance mechanisms limiting symptom expression even when infected. This phenotype is characteristic of quantitative resistance, allowing some viral replication but restricting systemic movement and symptom development (Fondong, 2017; Sheat & Winter, 2023). Such varieties may provide acceptable yield under moderate disease pressure but require careful management to prevent acting as inconspicuous virus reservoirs (Dye *et al*., 2023).

The moderate resistance in these varieties carries both opportunities and risks. They may be useful in integrated disease management where complete immunity is not essential, but their ability to harbor the virus without severe symptoms means they can contribute to background inoculum, potentially affecting neighboring susceptible varieties (Dye *et al*., 2023). Their deployment should therefore be accompanied by monitoring and integrated with other management practices.

Implications for the Sudan Savannah Agro-Ecology

The Sudan Savannah's distinct rainy season (June–September) coincides with peak whitefly activity and cassava growth, creating a concentrated transmission risk. High temperatures can accelerate whitefly development and reduce virus incubation periods (Katono *et al*., 2022). The complete resistance observed in six improved varieties under these conditions is encouraging, demonstrating that CMD2-mediated immunity remains effective even under environmental conditions favoring disease development.

The identification of multiple immune varieties provides farmers with deployable options to reduce losses. OBASANJO 2 and GAME CHANGER, in particular, have demonstrated high yield potential in addition to disease resistance (IITA, 2025). Their promotion through extension and seed systems should be prioritized. However, persistent susceptible landraces remain a concern. Replacement programs must address farmer preferences and perceptions through participatory approaches (Ntawuruhunga *et al*., 2013), and ensure access to clean planting materials through community-based seed multiplication to break disease perpetuation (Thresh & Cooter, 2005).

Comparison with Regional Studies

The findings align with recent research on CMD dynamics across West Africa. The complete susceptibility of local landraces mirrors reports from Guinea and Sierra Leone, where traditional varieties lacking resistance genes are highly vulnerable to begomoviruses, including the emerging threat of EACMV-UG (Combala *et al*., 2024; Saffa *et al*., 2025). Recent regional publications report incidence levels ranging widely depending on variety and location. For example, in Sierra Leone, released improved genotypes showed complete resistance while local varieties were susceptible (Saffa *et al*., 2025); in Cameroon, mean incidence across numerous fields was substantial (Doungous *et al*., 2022); and in Burkina Faso, national mean incidence declined notably between 2020 and 2022 (Sawadogo *et al*., 2025). The extreme susceptibility observed in DANGWAMNATI (very high incidence and severity) sits at the upper end of these regional observations, though this is partly due to the use of infector rows to artificially maximize inoculum pressure, making the present results not directly comparable to unmanipulated farmer-field surveys. The detection of EACMV-UG underscores the urgency of deploying resistant varieties, as CMD2-based resistance is effective against a range of begomovirus species (Ntui *et al*., 2024).

The moderate resistance in IBA 30572 and IBA 961632 is consistent with studies documenting partial resistance in some improved lines (Olasanmi *et al*., 2021). The identification of multiple immune varieties provides genetic resources for breeding programs seeking to pyramid resistance genes for enhanced durability. The temporal patterns observed are consistent with established CMD epidemiology (Legg *et al*., 2011).

CONCLUSION

This study provides the first comprehensive evaluation of cassava varieties under natural CMD infection in Nigeria's Sudan Savannah. Six improved varieties—OBASANJO 2, GAME CHANGER, BABA 70, IBA 0505, IBA 164773, and IBA 154810—showed complete field resistance with zero disease incidence throughout the trial, consistent with CMD2-mediated immunity. In contrast, local landraces DANGWAMNATI and BAHAUSHE displayed extreme susceptibility, acting as potential inoculum reservoirs. IBA 961632 was moderately susceptible, while IBA 30572 showed partial resistance. These findings establish baseline susceptibility categories to guide variety recommendations, breeding priorities, and policy interventions. However, multi-location, multi-season validation and molecular confirmation of resistance genes are recommended before large-scale deployment.

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