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# GROWTH PERFORMANCE OF ELEVEN IMPROVED CASSAVA VARIETIES AND THEIR SUSCEPTIBILITY TO SOME INSECT PESTS AND DISEASES IN HUMID TROPICS, RIVERS STATE

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**ABSTRACT:** *Study on the agronomic evaluation and disease resistance of eleven improved cassava varieties was carried out in Rivers State University Teaching and Research Farm in a Randomized Complete Block Design (RCBD). The eleven varieties assessed are TMS 30572, TMS 98/0510, TMS 98/0581, TMS 98/0505, TMS 92/0326, TME 419, TMS 01/1371, TMS 01/1368, TMS 07/0593, TMS 95/0289 and TMS 96/1632 were evaluated for plant height, leaf number, number of branches, number of flowers, insect infestation and disease incidence. The plant height of the cassava varieties revealed that eight varieties (TMS 01/1371, TMS 01/1368, TMS 30572, TME 419, TMS 98/0505, TMS 96/1632, TMS 98/0510 and TMS 07/0593) are tall varieties while TMS 98/0581, TMS 92/0326 and TMS 95/0289 are short varieties. The highest leaf number was recorded in TMS 01/1371 but the tall varieties like TMS 01/1368, TMS 96/1632 and TME 419 had low leaf number. TMS 98/0581, TMS 92/0326 and TMS 95/0289 were shown to have scanty leaves. TMS 01/1371 was significantly higher ($P<0.05$) than other varieties in plant height, leaf number and branches. Four varieties flowered namely TMS 07/0593, TMS 01/1371, TMS 30572 and TMS 98/0505. TMS 30572 and TMS 92/0326 were highly susceptible to both African Cassava Mosaic and Xanthomona sp. (Bacterial blight diseases) while TMS 95/0289, TMS 01/1368 and TMS 98/0505 were less susceptible to African Cassava Mosaic virus disease alone. Insect infestations (White fly: Bemisia sp. and Mealybugs: Phenacoccus sp.) on the tested varieties were significantly minimal though five cultivars (TMS 98/0505, TMS 96/1632, TMS 98/0510, TMS 98/0581 and TMS 95/0289) were completely resistant. Therefore, there is urgent need to withdraw the varieties that are susceptible, and use more of the varieties that are disease resistant for high crop yield, breeding and higher productivity*.

**KEY WORDS:** Cassava, varieties, resistance, susceptibility and agronomic assessment.

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## INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a dicotyledonous crop belonging to the family Euphorbiaceae, Phylum Magnoliophyta, genus *Manihot* and species *esculenta* (Cronquist, 1981). It was introduced into Africa by Portuguese and Spanish traders from Brazil in the 16$^{th}$ century and widely grown as a staple food and animal feed in countries of tropical and subtropical Africa, Asia and Latin America between latitude 30$^{o}$N and 30$^{o}$S with a total cultivated area over 13 million hectares (Nweke, 2005; Hershey, 2000). Cassava is propagated by stem cuttings or sexual seeds and cultivation through stem cutting is the most common mode of propagation in Africa (Abass *et al.,* 2014). Land preparation for cassava on upland or lowland varies as farmers either plant on flat ground, mounds or ridges on upland while on lowland/valley farmers prepare ridges or mounds above ground level to control water logging, cassava needs a loose-textured soil to facilitate initial root penetration and also allow for root thickening (Abass *et al.,* 2014). Stem cuttings to be planted should be from older and mature stems as they give better yield than young stems; thick stems should be propagated because thin stem have little nutrient and moisture and also produces only few and small tuberous root (Abass *et al.,* 2014).

Cassava is currently the most important food source for carbohydrate, after rice, sugarcane and maize for over 500 million people in the developing countries of the tropics and subtropics. Its main value is in its storage roots with dry matter containing more than 80% starch and higher amount of food calories, per hectare than do most other tropical crops. Cassava is also processed to cassava chips, pellets, flour for consumption tapioca, garri. Industrial and non-food uses of cassava starch or starch derivatives include: food processing industries; noodles, yoghurts, canned fruits, soft drinks, snack foods and taste enhancers, paper, card board, plywood, pharmaceutical and chemical industry; soaps, detergents, bleaches, insecticides, industrial alcohols, combustibles, adhesives, cosmetics and water treatment agents (El-Sharkawy, 1993; Onwuene, 1978).

However, cassava production in Nigeria is faced with threat caused by virus, bacteria, fungi and insect. The most common diseases affecting cassava production are Cassava mosaic virus disease (CMD), Cassava bacterial blight (CBB), Cassava brown streak disease (CBSD), Cassava anthracnose disease, Cassava leaf spot disease and Cassava root rot; the insect pest causing significant yield losses in cassava production are whitefly, mite and mealy bugs (FAO, 2013). To mitigate this threat, strategies were adopted by a large pool of national agricultural research systems like IITA, industries, universities, government and farmers to replace susceptible varieties on the farmers' field with superior genotypes that are not only resistant but also high yielding with high dry matter content (Dixon *et al.,* 2010). Dhaliwal *et al.* (2013) reported that global warming may result in breakdown of resistance to certain insect pests and also natural enemies of pest species. In view of the time lag since the initial release of the improved varieties, there could have been a breakdown in resistance to diseases and breakdown of the heritable qualities due to

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mutation, climate change and resistance pressure. Hence, a review of the performance of eleven improved varieties released by IITA is studied to ascertain the current performance in Humid Tropics.

## MATERIALS AND METHODS

### Study Area

The cassava evaluation site was in the Rivers State University Teaching and Research farm, Port Harcourt. Port Harcourt is in the humid forest zone with mean annual rainfall of about 2400mm distributed March to November; Temperatures range from $27^0$C and humidity could be about 89% from July to September. The soil of the study area was a sandy-loam soil.

### Cassava varieties Evaluated

The cassava varieties evaluated include: TMS 01/1371, TMS 96/1632, TMS 98/0510, TME 419, TMS 98/0581, TMS 01/1368, TMS 07/0593, TMS 98/0505, TMS 30572, TMS 92/0326 and TMS 95/0289. These varieties are improved varieties released from IITA.

**Table 2.1: Year of release of the different improved varieties**

| Varieties | Year of Released |
|---|---|
| TMS 01/1371 | 2011 |
| TMS 96/1632 | 2006 |
| TMS 98/0510 | 2005 |
| TMS 98/0581 | 2005 |
| TME 419 | 2005 |
| TMS 01/1368 | 2011 |
| TMS 98/0505 | 2005 |
| TMS 30572 | 1984 |
| TMS 92/0326 | 2006 |
| TMS 07/0593 | 2014 |
| TMS 95/0289 | 2005 |

### Parameters Monitored

### Measurement of Plant Height

Plant height was taken for 10 tagged stands in each of the four (4) replicates of each variety.

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**Measurement of Leaf Number**

Leaf number was counted for five (5) cassava stands per replicate.

**Measurement of Disease Incidence**

Disease incidence was obtained by counting the total number of disease stands per replicate.

**Determination of Branched Stands and Flowers**

The number of branched stands and flowers was obtained by counting the number of branched stands and flowers per replicate of 90 stands.

**Insects Numbers**

Insect numbers was obtained by counting the number of stands with insects per replicate.

**Damage Assessment on the Leaf:** Visual assessment of damage was used (Compton, 1991, Dixon *et al.*, 2010). The number of diseased leaves of the cassava plant was used as bases and this was rated into a 5-grade scale as slated below:

0 sign – No damage

1-5 signs – Slightly damage

5-10 signs – Average damage

10-15 signs – Severe damage

15 signs or above – Very severe damage

**Experimental Design**

The 11 varieties was planted in a Randomized Complete Block design (RCBD) and replicated 4 times. Each replicate had 90 stands at a spacing of 1 by 1 meter which gave a total of 10,000 stands per hectare. The land area covered by the eleven (11) varieties is 4320m$^2$.

**Data Analysis**

Data collected was summarized in excel spread sheet and analyzed using computer Minitab software. Significant means were separated using Tukey's Pairwise comparison grouping method (Minitab, 2010).

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**RESULTS**

The experimental result on plant height of the eleven improved cassava varieties indicated that TMS 01/1371 was significantly higher than other varieties ($P<0.05$) in all the months sampled with mean value of 158.1, followed by TMS 01/1368 with a mean value of 146.6, the variety with the least height sampled during the sampling period was TMS 95/0289 with mean value of 36.1 (Fig. 1). Data obtained for leaf number for the different varieties in Fig. 2 showed that TMS 01/1371 had the highest ($P<0.05$) leaf number with mean value of 150.0, the least number of leaves recorded in this study was observed in TMS/0289 with mean value of 36.1 while results obtained for the number of branches amongst cassava varieties indicated that TMS 01/1371 had the highest number of branches with mean value of 76.4, while the least number of branches was recorded in TMS 98/0581 with mean value of 0.7 (Fig.3). Table 1 on the varietal difference in the number of flowered cassava varieties showed that TMS 07/0593 was significantly higher at 5% probability, but there was no significant difference ($P>0.05$) between the cassava varieties (TMS 01/1368, TMS 98/0510, TME 419, TMS 92/0326, TMS 98/0581, TMS 95/0289 and TMS 96/1632).

Incidence of Cassava mosaic amongst varieties indicated that TMS 30572 was more susceptible to Cassava mosaic disease, while the least susceptibility was recorded in TMS 95/0289 (Table 2). Table 3 illustrated that TMS 01/1368 was more susceptible to Cassava bacterial blight disease, while the least susceptibility was recorded amongst TMS 95/0289, TMS 98/0581, TMS 98/0505 and TMS 07/0593 respectively. TMS 30572 had a significantly higher disease incidence for both diseases (Cassava bacterial blight and Mosaic diseases) ($P<0.05$), with mean value of 47.3, while the least disease incidence was recorded in TMS 95/0289 with mean values of 0.0 (Table 4). The rating of the these cassava variety in the number of damaged leaf scale revealed that the leaves of TMS 01/1368, TMS 92/0326, TMS 07/0593, TMS 96/1632 and TMS 30572 were severely damaged by cassava bacterial blight disease; Cassava mosaic disease was severe on the leaves of TMS 92/0326, TMS 98/0510 and TMS 30572 (Table 4). Also, three varieties (TMS 01/1368, TMS 98/0505 and TMS 95/0289) were reported to be resistant to cassava mosaic disease while results obtained for number of insects on the different varieties were statistically insignificant with just mean difference, while results obtained for the number of insects in the different months also indicated statistically insignificant difference, with highest infestation on TMS 01/1371 followed by TMS 30572, TMS 01/1368, TMS 07/0593, TMS 92/0326 and least on TME 419 while the rest varieties (TMS 98/0505, TMS 96/1632, TMS 98/0510, TMS 98/0581 and TMS 95/0289 zero infestation (Table 5).

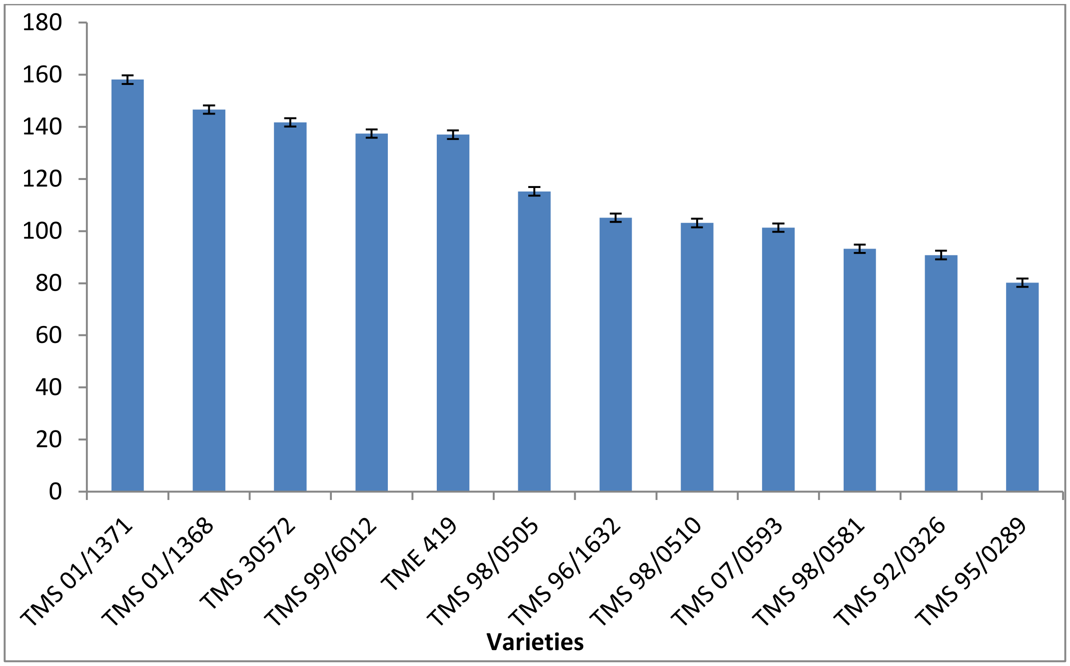


**Fig. 1: Plant Height of the different Cassava varieties**

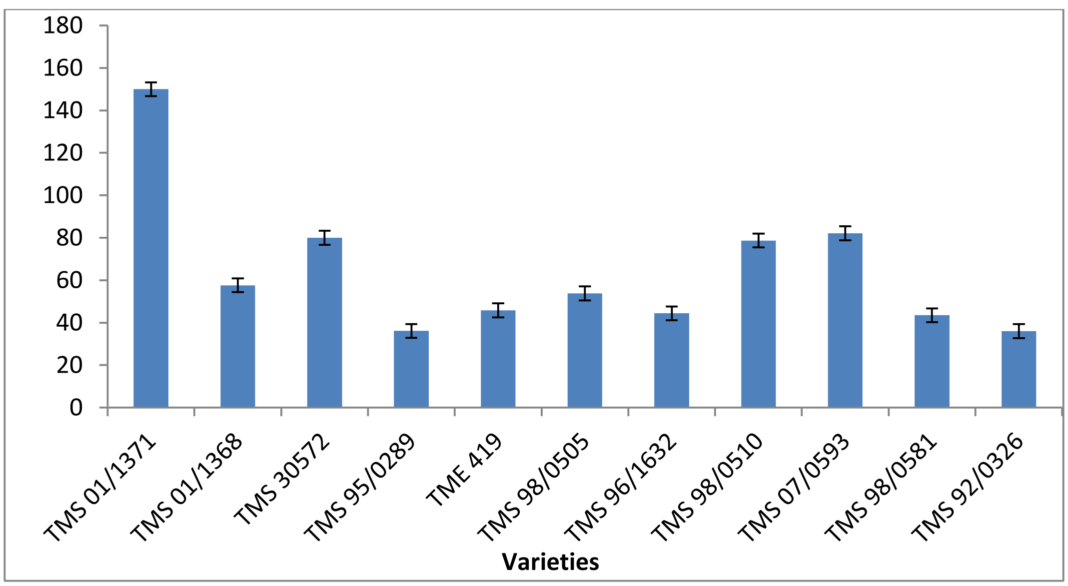


**Fig. 2: Leaf Number of the different Cassava varieties**

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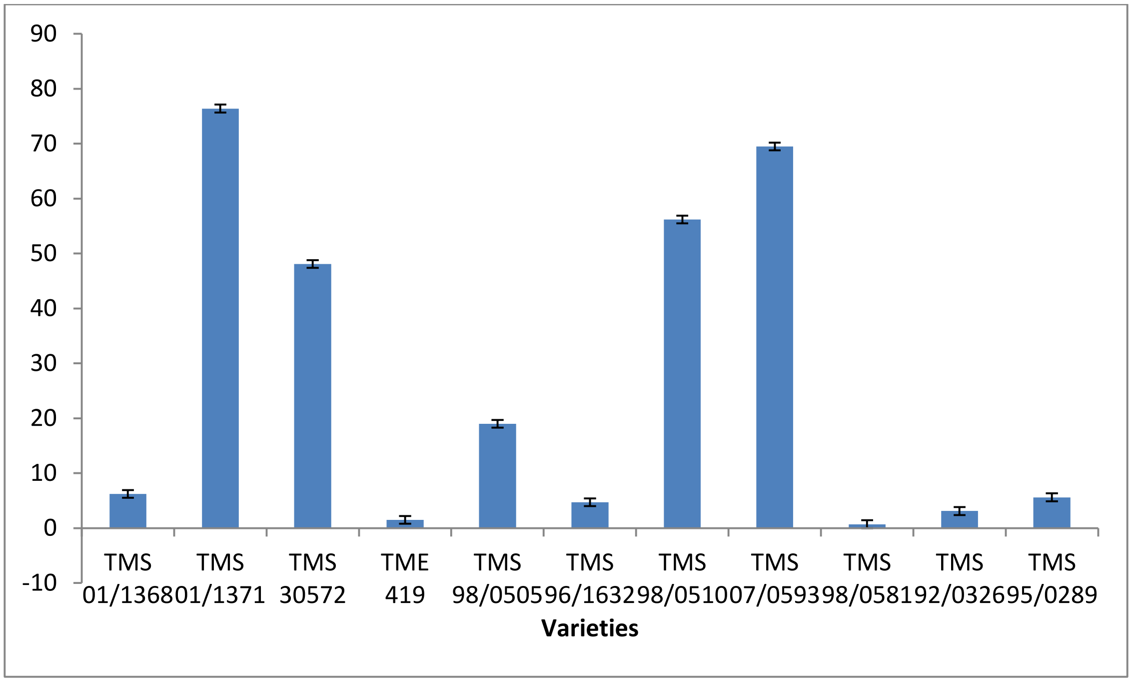


**Fig. 3: Varietal difference in the number of branches**

**Table 1: Varietal difference in the number of flowered Cassava varieties**

| Variety | Mean |
|---|---|
| TMS 01/1371 | 36.9[a] |
| TMS 01/1368 | 0.0[c] |
| TMS 30572 | 20.7[b] |
| TME 419 | 0.0[c] |
| TMS 98/0505 | 7.4[c] |
| TMS 96/1632 | 0.0[c] |
| TMS 98/0510 | 0.0[c] |
| TMS 07/0593 | 37.2[a] |
| TMS 98/0581 | 0.0[c] |
| TMS 92/0326 | 0.0[c] |
| TMS 95/0289 | 0.0[c] |

*Means that do not share same letter are significantly different (Tukey method at 95% Confidence level)

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**Table 2: Varietal difference in the disease incidence of Cassava Mosaic Virus Disease**

| Variety | Mean |
|---|---|
| TMS 01/1371 | $11.3^{c}$ |
| TMS 01/1368 | $0.0^{d}$ |
| TMS 30572 | $42.8^{a}$ |
| TME 419 | $0.4^{d}$ |
| TMS 98/0505 | $0.0^{d}$ |
| TMS 96/1632 | $0.2^{d}$ |
| TMS 98/0510 | $32.6^{b}$ |
| TMS 07/0593 | $0.5^{d}$ |
| TMS 98/0581 | $0.3^{d}$ |
| TMS 92/0326 | $31.1^{b}$ |
| TMS 95/0289 | $0.0^{d}$ |

*Means that do not share same letter are significantly different (Tukey method at 95% Confidence level)

**Table 3: Varietal difference in the disease incidence of Cassava Blight Disease**

| Variety | Mean |
|---|---|
| TMS 01/1371 | $2.3^{d}$ |
| TMS 01/1368 | $8.6^{a}$ |
| TMS 92/0326 | $5.5^{b}$ |
| TME 419 | $3.4^{c}$ |
| TMS 98/0505 | $0.2^{d}$ |
| TMS 96/1632 | $5.6^{b}$ |
| TMS 98/0510 | $0.3^{d}$ |
| TMS 07/0593 | $6.0^{b}$ |
| TMS 98/0581 | $0.0^{d}$ |
| TMS 30572 | $7.3^{a}$ |
| TMS 95/0289 | $0.1^{d}$ |

*Means that do not share same letter are significantly different (Tukey method at 95% Confidence level)

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**Table 4: Number of diseased leaves and its damage on the studied Cassava varieties**

| Variety | Cassava Bacterial Blight Disease | Cassava Mosaic Disease |
|---|---|---|
| TMS 01/1371 | Average damaged | Average damage |
| TMS 01/1368 | Severely damaged | No damage |
| TMS 92/0326 | Severely damaged | Severely damaged |
| TME 419 | Average damaged | Slightly damage |
| TMS 98/0505 | Slightly damaged | No damage |
| TMS 96/1632 | Severely damaged | Slightly damaged |
| TMS 98/0510 | Slightly damaged | Severely damaged |
| TMS 07/0593 | Severely damaged | Slightly damaged |
| TMS 98/0581 | Slightly damaged | Slightly damaged |
| TMS 30572 | Severely damaged | Severely damaged |
| TMS 95/0289 | Slightly damaged | No damage |

**Table 5: Varietal difference in the number of Insect on Cassava**

| Variety | Mean |
|---|---|
| TMS 01/1371 | 0.8[a] |
| TMS 01/1368 | 0.5[a] |
| TMS 30572 | 0.7[a] |
| TME 419 | 0.1[a] |
| TMS 98/0505 | 0.0[a] |
| TMS 96/1632 | 0.0[a] |
| TMS 98/0510 | 0.0[a] |
| TMS 07/0593 | 0.4[a] |
| TMS 98/0581 | 0.0[a] |
| TMS 92/0326 | 0.4[a] |
| TMS 95/0289 | 0.0[a] |

*Means that do not share same letter are significantly different (Tukey method at 95% Confidence level)

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**Plate 1a: Cassava mosaic disease on TMS 30572** **Plate 1b: Cassava mosaic disease on TMS 01/1371**

**Plate 2a: Cassava Bacterial blight on TMS** **Plate 2b: Cassava Bacterial blight on TMS 92/0326**

**30572**

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**DISCUSSIONS**

Agronomic evaluation of the eleven cassava varieties is very essential as it aids the farmer to distinctively identify their different characteristics. The plant height of the cassava varieties showed that eight varieties (TMS 01/1371, TMS 01/1368, TMS 30572, TME 419, TMS 98/0505, TMS 96/1632, TMS 98/0510 and TMS 07/0593) are tall varieties while TMS 98/0581, TMS 92/0326 and TMS 95/0289 are short varieties. The highest leaf number was recorded in TMS 01/1371 but the tall varieties like TMS 01/1368, TMS 96/1632 and TME 419 had low leaf number. TMS 98/0581, TMS 92/0326 and TMS 95/0289 were shown to have scanty leaves. Flowering only occurred in four varieties out of eleven varieties studied. The flowered varieties are TMS 07/0593, TMS 01/1371, TMS 30572 and TMS 98/0505. These findings on flowering contradicted that of Dixon *et al.* (2010) who stated that flowering occurred in cultivars TMS 96/1632 and TMS 98/0510 planted in Ibadan. This variation in flowering of the different varieties when compared to that done in Ibadan may be due to environmental factors. It is noteworthy to say that all the varieties used in this experimental research branched with TMS 01/1371 having the highest number of branches.

Cassava mosaic and cassava bacterial blight diseases has caused severe damage which led to drastic increase in the market prices of cassava and its product. TMS 01/1368, TMS 98/0505 and TMS 95/0289 were less susceptible to cassava mosaic disease and this agrees with the result of Dixon *et al.* (2010) who listed it among the 59 improved varieties released by IITA and NRCRI to combat cassava diseases. This resistance of TMS 01/1368, TMS 98/0505 and TMS 95/0289 to cassava mosaic disease might be due to differential genotypic/phenotypic sensitivities, varying reactions to virus, inherent resistant genes resulting from their different pedigree (Emehute *et al.*, 1998; Dixon *et al.,* 2010; Dimkpa *et al.,* 2015). The reduction or breakdown of the resistance of these improved cassava varieties may be due to global warming, climatic change, alteration of the ecosystem through improper agronomical and industrial activities, gas flaring etc. which could result to mutation of single or multiple genes thereby making the cassava varieties susceptible to attack by both pathogenic organism and insects (Sharma, 2010; Dhaliwal and Kukal, 2005; Dhaliwal *et al.,* 2013; Dimkpa *et al.,* 2015). This susceptibility of these improved varieties may be as a result of the climatic condition of humid tropics which is a favourable breeding ground for development of pathogenic organisms thereby exposing the plants to high colonization of these pest organisms. The experimental results also revealed that TMS 92/0326 and TMS 30572 were susceptible to both Cassava mosaic and bacterial blight diseases with TMS 30572 recording the highest degree of susceptibility and this may be attributed to the change of climatic condition from 1984 when it was released to present year. However, some cassava varieties showed more symptoms of the infestation during the dry season as they become older which is attributed to the population dynamics of these notorious pests and diseases of cassava as they tend to breed better in the environment during drought (NRI., 1996).

Findings from this research showed that Insect infestations (White fly: *Bemisia sp.* and Mealybugs: *Phenacoccus sp.*) on the tested varieties were significantly minimal though five cultivars (TMS 98/0505, TMS 96/1632, TMS 98/0510, TMS 98/0581 and TMS 95/0289) recorded zero infestation Table 5. These resistant varieties were released by IITA in 2005 and 2006 (Dixon *et al.*, 2010) and has maintained their resistance till now. However, the experimental result revealed that TMS 30572, 92/0326 and TME 419 which were released same time by IITA incured slight insect infestation. It is therefore worthy to state that the studied varieties are generally less susceptible to both whitefly and Mealybugs as the infestation of these insects pest were below economic threshold level.

## CONCLUSIONS

This study assessed the field performance of eleven improved cassava varieties in which TMS 01/1371 was higher significantly in plant height, leaf number and branches than the other varieties. It also revealed that four varieties (TMS 07/0593, TMS 01/1371, TMS 30572 and TMS 98/0505) out of the eleven varieties flowered. While eight varieties out of the eleven varieties studied were tall varieties. It further established that TMS 30572 and TMS 92/0326 were highly susceptible to both Cassava mosaic virus and Bacterial blight diseases while TMS 95/0289, TMS 01/1368 and TMS 98/0505 cassava varieties were less susceptible to cassava mosaic virus disease. Insect infestations (Whitefly and Mealybugs) on the tested varieties were significantly minimal and five cultivars (TMS 98/0505, TMS 96/1632, TMS 98/0510, TMS 98/0581 and TMS 95/0289) were completely resistant to the studied insects. It is therefore, necessary to withdraw the circulation of varieties that are highly susceptible, and use more of the less susceptible varieties for further breeding programme to enhance insect pest and disease resistant, high crop yield and productivity.

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