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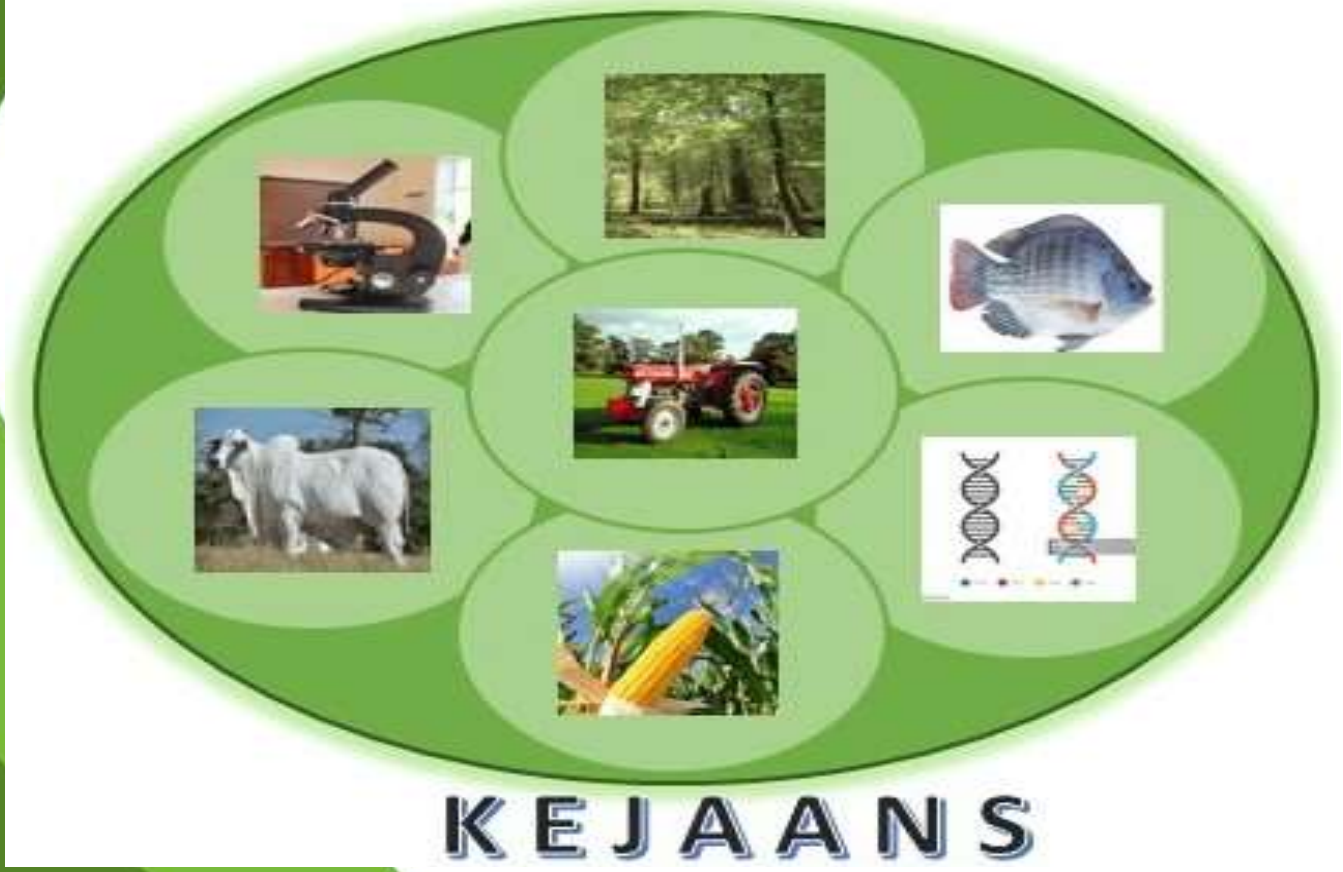

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About the Journal

This official scientific publication of the Faculty of Agriculture, Abdullahi Fodio University of Science and Technology Aliero, is a non-profit, open access, double-blind peer-reviewed Journal publishing four issues (January, April, July and October) per annum. The Journal is a platform open to collaborations with researchers, authors, institutions, research agencies and private companies related to Agriculture. The Mission of the Journal is to disseminate scientific knowledge through the publication of original research articles, research notes, book reviews, letters to the editor and reviews of Literature, representing a contribution to scientific and technological knowledge in respective areas covered by the Journal. The Kebbi Journal of Agriculture and Natural Sciences seeks to validate and disseminate new knowledge, making it public in order to strengthen the human capacity, constitute a link in the scientific community to the society and encouraging the expansion of University and academic researches.

Scope of Kebbi Journal of Agriculture and Natural Sciences (KEJAANS)

The Kebbi Journal of Agriculture and Natural Sciences has the sole aim of providing an intellectual platform and ideas for scholars, by promoting interdisciplinary studies related to agriculture and natural science through publishing the latest scientific research findings that are of direct policy implications and beneficial to the research community. Consequently, the journal covers all aspects of Crop Science, Animal Science, Agricultural Economics, Agricultural Extension and Rural Development, Food Science, Fisheries and Aquaculture, Biotechnology, Soil Science and Agricultural Engineering, Forestry and Environment, Wildlife, Agricultural Education, Agro-allied Industries as well as all Natural Science researches related to Agriculture.

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AN EPIDEMIOLOGICAL ASSESSMENT OF CASSAVA MOSAIC DISEASE AND WHITEFLY (*Bemisia tabaci*) ABUNDSNCE ON CASSAVA (*Manihot esculenta* Cranz) LANDRACES IN ALIERO, KEBBI STATE

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ABSTRACT

Cassava is an important root crop grown in tropical and subtropical regions. The crop is considered as potential solution to food crisis in Nigeria and Africa. A field experiment was carried out during 2022/2023 rainy season at the premises of Screen House of Abdullahi Fodio University of Science and Technology, Aliero to screen Cassava landraces for resistance to Cassava Mosaic Disease (CMD) and whitefly abundance in Aliero. Diseased-free cassava cuttings were sourced from Northwest and Northeast Nigeria. The cassava stems were preserved in a jute bag during the collection. The treatment consisted of nine (9) Cassava landraces (Dan Ware, Dan Gwamnati, Jan Rogo, Barunje, Dan Obasanjo, Dan Ajafa, Bahaushe, Bakin Iri and TMS 0505 (Control). The treatments were laid out in a Randomized Complete Block Design (RCBD) with three replications. Stem cuttings were dipped in a pre-formulated insecticide (Perfect Killer (2ml/ltr)), transplanted and maintained in well-prepared ridges at the spacing of 0.5 m x 1 m while 1m was left between each Block. CMD infested (inoculum) cuttings were transplanted across the ridges for transmission. Data were collected on Sprout count, incidence, severity and whitefly abundance. Data obtained were subjected to Analysis of Variance (ANOVA) and means were separated using Least Significance Difference at *(P<0.05)* Probability level. The results showed that Dan Ajafa was promising in terms of sprouting at 1WAT and significantly same with Bahaushe and Dan Obasanjo at 2 WAT. Same trend was observed in terms of incidence as Dan Ajafa and Bahaushe had higher disease incidence at 4 WAT while Barunje recorded moderate but higher mean disease severity. Barunje also recorded higher mean whitefly at 2 and 4 WAT but Dan Obasanjo ranked first at 6 WAT. Therefore this study concluded that Dan Ajafa can be used by the farmers for both seed multiplication and root production for sustainable cassava production.

Keywords**:** *Bemisia tabaci*, Cassava, landraces, Transplanting, Transmission

Introduction

Cassava (*Manihot esculentus* Crantz) is one of the leading staple foods in Nigeria. It is grown mainly for its enlarged starch-filled root which is used for human consumption, it is an energy-dense food and therefore, ranked high for its calorific value of 250 x 103cal/ha/day (Jisha *et al.*, 2010). Cassava is a source of income and its production is vital to the economy of Nigeria as the country is the world's largest producer of the commodity; the crop is produced in 24 of the country's 36

states (FAO, 2014). It is an important food security crop in Nigeria due to its increasing demand by the entire populace, as a result of the rapid population growth rate of the country (FAO, 2014). Cassava can be processed into different intermediate finished products such as cassava flour, starch, cassava chips and *garri*. Due to its high amylose and starch content it is used to produce high fructose syrup and glucose for beverage and in the pharmaceutical industries (Afoakwa *et al.,* 2012).

There are many factors that serve as constraints to cassava production this includes; diseases, insects, soil, weeds and agronomical factors (FAO, 2014). Insects such as cassava mealybug, cassava green mite and whitefly affect cassava production through introduction of viral diseases (Fauquet *et al.,* 2018). Cassava mosaic disease (CMD) is another major constraint, to cassava production in Africa and is caused by eight distinct members of the family Geminiviridae, commonly referred to as Cassava mosaic Geminiviruses (CMGs) (Fauquet and Stanley, 2003; Thresh and Cooter 2005). CMD can results in stunting and severe reduction of about 20% to 95% in the yield of the desired tuberous cassava root and can cause production threat to cassava which feeds over 200 million people in sub-Saharan Africa. (Ogbe *et al.,* 2003). CMD has been reported to occur at varying levels of incidence throughout the cassava belt of Africa (Alabi *et al.,* 2011). For many years African cassava mosaic virus (ACMV) was confirmed as the causal agent of CMD, it remained the only known causal agent of CMD in Nigeria until the 1990s when East African cassava mosaic Cameroon virus (EACMCV) and several variants of the EACMV were diagnosed as additional causative agents (Ogbe *et al.,* 2006; Alabi *et al.,* 2008). This research aimed at assessing the cassava landraces for resistance to cassava mosaic virus and whitefly abundance in Aliero, Kebbi State.

Materials and Methods

The experiment was conducted at the premises of the screen house of Abdullahi Fodio University of Science and Technology, Aliero, during 2022/2023 raining season from (June to November, 2023). The area is located in Kebbi State, Sudan Savannah Zone of Nigeria. The climate of the area is characterized by annual rainfall range from 550-700mm and temperature average between 30°C during dry season and 27°C and 41°C during the raining season and the relative humidity range from 21 to 47 percentage in the dry season and 51 to 79 percentage during rainy season (Hassan and Knight, 2023). The area characterized by long dry season with a cool air during hammatan (November to February), followed by short rainy season may/June to September/October (Anonymous 2011).

Sources of Cassava Cuttings

The diseased-free cassava cuttings were sourced from the Northwest and Northeast Nigeria. Cassava stems were properly labeled and preserved in a jute bag during the collection Plate 1.

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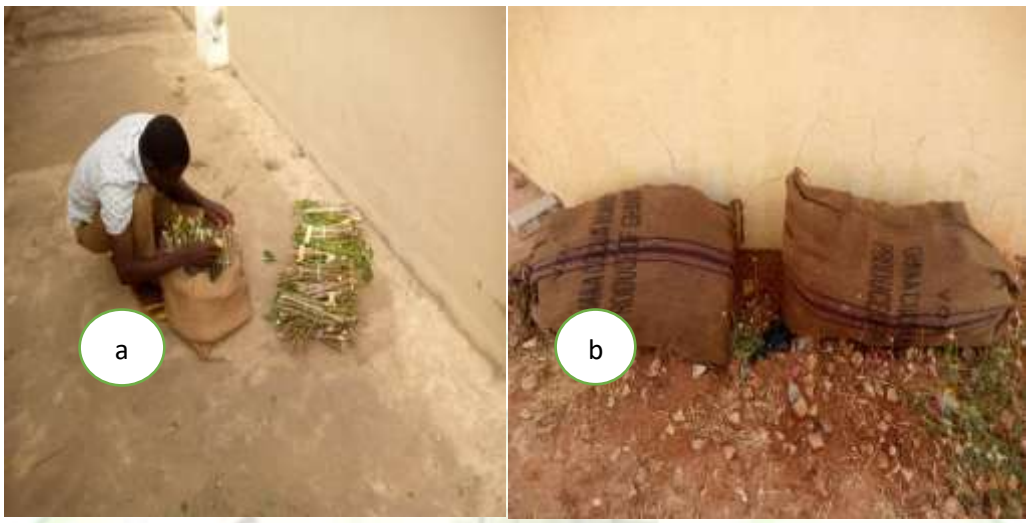

Plate 1: (a) Cassava stem cuttings arranged in a jute bag (b) Cassava stem cuttings preserved in a jute bag

Treatments and Experimental Design
Treatment consisted of nine cassava landraces namely; Dan Ware, Dan Gwamnati, Jan Rogo, Barunje, Dan Obasanjo, Dan Ajafa, Bahaushe, Bakin Iri and Tms 0505 as Control.
The treatments were laid out in a Randomized Completely Block Design (RCBD) with three replicates.

Land Preparations and Transplanting
The land was cleared, ploughed and the ridges were properly prepared, about 5-7cm stem cuttings were dipped in a pre-formulated insecticide (Perfect Killer (2ml/ltr) and transplanted in well-prepared ridges at the spacing of 0.5 m x 1 m while 1m was left between each Block to serves as foot path. A total number of ten (10) cuttings were maintained in each ridge while diseased stem cuttings were transplanted across the ridges as inoculum for transmission.

Weeding
Manual weeding was carried out two weeks after transplanting and subsequently when the weeds were observed in the experimental site.

Data Collection

Spout Count
Sprout count was done by counting the number of stand sprouted in each ridge; this was done in at 1 and 2WAT,

Whitefly Count
Whiteflies were directly counted on fully expanded terminal leaves of five randomly selected plants and the averages were calculated and recorded. This was done in the morning and evening when the insects are least mobile.

Disease Incidence
Disease incidence was calculated according to the method developed by **(**Sseruwagi *et al.,* 2004)

$$\text{Disease incidence (\%)} = \frac{number\ of\ diseased\ plants}{total\ number\ of\ plants\ examined} \times 100$$

Disease symptom severity
Cassava plants were assigned disease severity scores based on the standard five point scoring scale for cassava mosaic Disease **(**Sseruwagi *et al.,* 2004) 1: symptomless, 2: Mild, 3: Severe, 4: Very severe and5: Extremely severe.

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Data Analysis

Data obtained on number of sprout, disease incidence, severity and mean whitefly count were subjected to Analysis of Variance (ANOVA) while means were separated using Least Significant Difference at *(P<0.05)* probability level

Results

Percentage (%) Stand Sprout at 1 and 2 WAT

The results on sprouting revealed that, all cassava landraces sprouted at 1 and 2 WAT. However, Dan Ajafa (100.00^{a}) had the highest percentage of cutting sprouted at 1 WAT than Bahaushe which was the second (96.67^{a}), Dan Obasanjo (93.33^{a}) was ranked third while the least was recorded by Dan Ware with (53.33^{d}). However at 2 WAT Dan Ajafa and Bahaushe and Dan Obasanjo recorded the higher and same percentage of sprouted cutting (100.00^{d}), followed by Dan Gwamnati (96.66^{a}), Same Dan Ware had the least (86.66^{d}) (Table 1).

Table 1. Percentage (%) Stand Sprout at 1 and 2 Week after Transplanting

Treatments	Percentage Stand Sprout (%) at 1 WAT	Percentage Stand Sprout (%) at 2 WAT
Dan Ajafa	100.00^{a}	100.00^{a}
Bahaushe	96.67^{a}	100.00^{a}
Dan Obasanjo	93.33^{a}	100.00^{a}
Barunje	90.00^{a}	90.00^{a}
Bakin Iri	86.67^{a}	100.00^{a}
Dan Gwamnati	83.33^{a}	96.66^{a}
Jan Rogo	73.33^{b}	93.33^{a}
Dan Ware	53.33^{b}	86.66^{b}
TMS 05 05 Control	70.00^{b}	90.00^{a}
LSD *(P<0.05)*	**21.39**	**12.78**

Within a treatment group mean followed by the same letters ($S^{\cdot}$) are not significantly different at 0.05% probability level. WAT: Weeks After Transplanting

Disease Incidence and Severity of Cassava Mosaic Disease at 4 WAT

The results on the disease incidence and symptom severity of CMD showed that, there is statistical difference among cassava landraces at *(P<0.05)* Probability level. Barunje landrace (73.33^{a}) had the highest disease incidence over other cassava landrace. However Dan Ajafa, Bahaushe and Jan Rogo landraces were ranked second with similar disease incidence percentage (66.67^{b}), the least was recorded by Dan ware (10.00^{f}). Similar trend was observed as same ecotype Barunje revealed the high symptom severity with (1.83a), followed by Dan Ajafa (1.75^{a}) which was significantly same with Bahaushe and Jan Rogo (1.66^{a}). Dan ware also recorded the least (0.25^{b}) (Table 2).

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Table 2: Disease Incidence and Severity of Cassava Mosaic Disease at 4 Weeks After Transplanting

Treatments	Disease Incidence (%) at 4 WAT	Symptom Severity at 4 WAT
Dan Ajafa	66.67[b]	1.75[a]
Bahaushe	66.67[b]	1.66[a]
Dan Obasanjo	26.67[d]	0.66[b]
Barunje	73.33[a]	1.83[a]
Bakin Iri	50.00[c]	1.25[a]
Dan Gwamnati	20.00[c]	0.50[b]
Jan Rogo	66.67[b]	1.66[a]
Dan Ware	10.00[f]	0.25[b]
TMS 05 05 Control	16.67[c]	0.41[b]
LSD *(P<0.05)*	**6.02**	**1.41**

Within a treatment group mean followed by the same letters (S·) are not significantly different at 0.05% probability level. WAT: Weeks After Transplanting

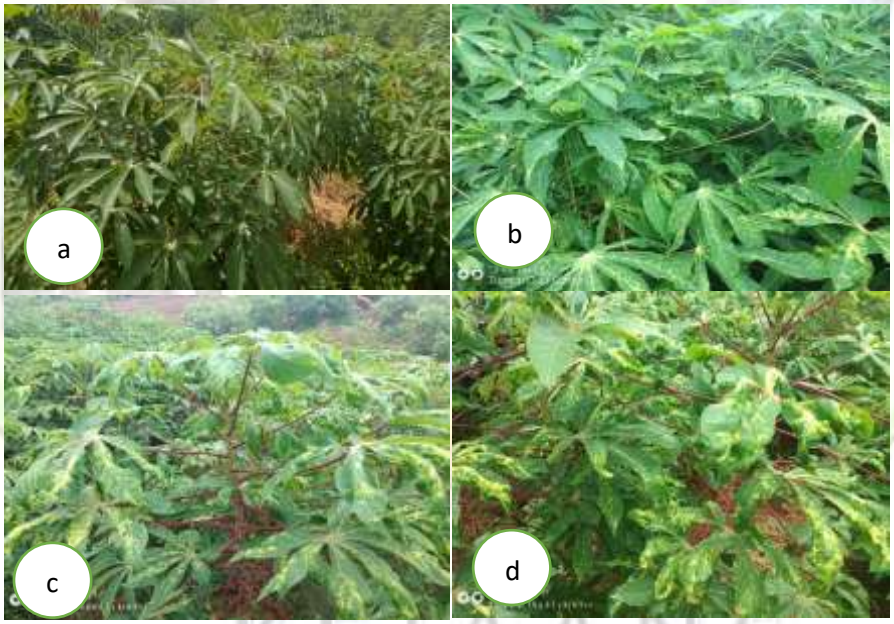

Plate 2: (a) Score 1 (b) Score 2 (c) Score 3 (d) Score 4

Whitefly Abundance at 2, 4 and 6 Weeks After Transplanting

Results on whitefly abundance showed that, there is significance difference among the cassava landraces at *(P<0.05)*. Bahaushe and Barunje (8.33[a]) recorded same and higher whitefly abundance followed by Dan Ajafa and Dan Ware (8.00[a]) which were statistically same. Dan Obasanjo and Dan Gwamnati (7.66[a], 7.33[a]) were ranked third, the least were recorded by Baki Iri and TMS 0505 (5.33 [b], 4.33[b]) Table 3.

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Table 3: Whitefly Abundance at 2, 4 and 6 Weeks After Transplanting

Treatments	**Whitefly Abundance at 2 WAT**	**Whitefly Abundance at 4 WAT**	**Whitefly Abundance at 4 WAT**
Dan Ajafa	8.00[a]	0.00[e]	5.00[c]
Bahaushe	8.33[a]	11.00[b]	12.00[b]
Dan Obasanjo	7.66[a]	8.66[b]	15.33[a]
Barunje	8.33[a]	16.33[a]	12.33[b]
Bakin Iri	5.33[b]	11.66[b]	5.33[c]
Dan Gwamnati	7.33[a]	7.00[c]	6.66[c]
Jan Rogo	6.00[a]	3.66[d]	7.66[c]
Dan Ware	8.00[a]	7.66[c]	6.33[c]
TMS 05 05 Control	4.33[b]	8.00[b]	10.33[b]
LSD *(P<0.05)*	**3.16**	**3.59**	**3.34**

Within a treatment group mean followed by the same letters (S) are not significantly different at 0.05% probability level. WAT: Weeks After Transplanting

Discussion

Cassava mosaic disease (CMD) is a major threat to cassava production in Nigeria. This viral disease is widespread in cultivated areas of cassava in Africa (Adjata *et al.,* 2008) and can greatly reduce yields by 40-70% in most of the susceptible cassava varieties (Legg and Fauquet, 2004).

The study showed that there is statistical differences among the cassava landraces at *(P>0.05)* level of significance difference in all the parameters. The results on the spouting count showed that Dan Ajafa landrace had the more number of spouts at 1WAT while same landrace had similar results with Bahaushe and Dan Obasanjo which recorded (100.0[a]) at 2WAT.

This results is in line with the findings of (Sseruwagi *et al.,* 2019) who reported that a prominent leaf scar can tremendously enhances sprouting ability of cassava varieties than semi-prominent ecotypes, however this could be attributed to the adaptability of ecotypes to cope with the climatic conditions where the experiment was conducted. Moreover, Barunje landrace had higher disease incidence and symptom severity at 4WAT over other ecotype, although according to the local cassava farmers, some of the planting materials were donated by government to boot cassava production as such landraces could be bred for high yielding rather than resistance to cassava mosaic disease as reported by (Lapidot and Friedmann, 2002).) , this also supported the findings of (Mohammed *et al.,* 2017) who reported that most of the cassava landraces were bred by the research institutes and release to farmers for sustainable cassava production. This is in disagreement with the reports of (33) who stated that that fertility significantly increases CMD incidence and severity compared to trials without fertilizers.

Similarly many cassava improved varieties were initially undergoes breeding process either by International Institute for Tropical Agriculture (IITA) or National Root Crop Research Institute (NRCRI) before its released to cassava farmers for consumption.

Conclusion

This research concluded that, Dan Ajafa and TMS 0505 were promising in terms of Sprouting, but partially resistant to Cassava Mosaic Disease and whitefly infestation than other landraces Therefore, the two landraces

can gives more number of cuttings during the seed multiplication and probably higher productivity. In addition, proper cassava field management is required to achieve a better cassava yields. Host plant tolerant/resistance should continuously be used to manage some of these major pests and diseases.

Recommendations

1. The research recommends the use of resistant cassava varieties e.g TMS 0505
2. The use of proper field sanitation to prevents the spread of viruses (transmission) by the vector.
3. Removal of infected cassava plants and use of cleaned and disease-free stem cassava cuttings from the neighbors, as this will also prevent the spread of viruses into the farmers' fields

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