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Evaluation of Some Improved Varieties of Cassava (Manihot esculenta) (Crantz) for Resistance to cassava Bacterial Blight (CBB) in a Humid Forest Zone of Nigeria

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Abstract: *Ten improved varieties of cassava Manihot esculenta (Crantz) obtained from the International Institute of Tropical Agriculture (IITA) Ibadan and a local variety (Efuwa) which served as a local check were evaluated for resistance to Cassava Bacterial Blight (CCB) at the Rivers State Agricultural Development Programme (ADP) Research Farm Degema, Rivers State, Nigeria. The varieties were laid out in a randomized complete block design and replicated three times. Field observation showed that seven varieties were resistant to CBB infection with proportional increase in tuber yield except 91/02324, 97/3200 and 98/2101. Two categories of varieties were observed in the study. The first category consists 97/0162, 96/1642, 96/1632, 99/6012 and 94/0026 which had high resistance to CBB and good tuber yield (*$26.8t\ ha^{-1} - 35.32t\ ha^{-1}$*) thus having potential in reducing foliar diseases as well as increasing tuber yield. The second category: TMS 30572, 96/1642, 99/6012 and 94/0026 produced relatively high biomass (*$10.68t\ ha^{-1} - 23.32t\ ha^{-1}$*) and good tuber Yield (*$27.71tha^{-1} - 35.04tha^{-1}$*). This group cantherefore be cultivatedfor good foliage and tuber yield. The root number weight and above-ground biomass had a significant positive correlation with yield, while a negative correlation exists between incidence/severity and yield.*

Keywords: *Cassava bacterial blight (CBB),Improved varieties, Resistance, Local check and tuber yield.*

I. Introdcution

Cassava is one of the most important staple food crops in Africa. The crop's production is among the most staple of the world's major food crops. The storage roots can be left in the ground for up to three or more years, making it· available to consumers for a long period. The leaves are also widely consumed as vegetable in several countries in Africa. It can grow on a wide range of soils and can yield satisfactorily where most other crops fail (Hahn, 1984). It can grow in high rainfall areas and also in semi-arid regions because of its drought tolerance. The crop therefore, plays a vital role inalleviating famine by providing sustained food supplies when other crops fail. Despite the numerous advantages that cassava offers to millions of African producers and consumers, there were very little research and development activities on the crop in the continent until recently. This is partly due to the fact that the crop was and still considered erroneously as inferior since it is cheaper than cereals and the fact that there are numerous constraints in the production of the crop. As a result, concerted efforts are being made to overcome the numerous constraints that limit cassava production in the continent, particularly Nigeria.

Among such constraints are diseases such as mosaic virus and cassava bacterial blight. Cassava bacterial blight caused by *Xanthomonas campestris Pv. Manihotis* is present in almost all cropping areas. It was first reported in Nigeria in 1972 (Boher & Agboli, 1992) It starts during the rainy season with the establishment of the parasite on foliage. Bacteria from contaminated plants or plant debris in the soil are transmitted to the leaves by rain splash or insects. The bacteria then multiply on the underside of the leaves, where they form micro-colonies protected by mucus (Daniel and Boher, 1985a). This epiphytic multiplication contributes to the buildup of inoculi sufficient to contaminate lamina tissue through stomata or the wounds that are frequently caused by high winds. Leaf blight may occur as a result of a toxin produced by the parasite. (Perreaux, *et al*., 1982) In the absence of rainfall, the parasite stops spreading in the issues and the epiphytic populations disappear. The parasite can survive in stem and seed tissues and in plant debris which fall to the ground, but not in the soil (Daniel and Boher, 1985b). The disease cause loss of yield of tubers and planting material, thereby posing a threat to national food security. It is against this backdrop that International Institute of Tropical Agriculture (IlTA) initiated the development of improved cassava varieties which are disease resistant and high yielding. The improved varieties are however becoming less or moderately resistant to Cassava bacterial blight (CBB) (Omidiji*et al.* 1988; Osakwe *et al.* 2000). The objectives of this study therefore are to:

(i) evaluate the level' of resistance of various varieties of bacterial blight on farm and
(ii) Ascertain the relationship between the disease and tuber yield of cassava.

II. Materials and Methods

Study Area

The experiment was conducted on a typical sandy loam soil at Rivers State Agricultural Development Programme (ADP) Research farm, Degema, Rivers State. This farm is located in the high rainfall areas of Nigeria, on the latitude $4°41N$ and longitude$6°18E$. Annual rainfall is variable and ranges from an average of 2,000 to 2,500 mm (FAO, 1984). The rainfall pattern is essentially bimodal with peaks in July and September and periodically low precipitation in August, the annual temperature ranges between $25℃$and $28℃$. The experimental plot was previously cultivated with vegetable (Okra) and was dominated by grasses and sedges among which are *Sida acuta, Ageratum conizoides (L.), Panicum maximum (Jacq)* and others.

Soil Analysis

All soil analysis were done according to procedures outlined by Tel and Rao (1982). Soil samples from five points at 0 – 15 cm at 0 – 15 cm and 15 – 30 cm were collected per location for chemical analysis in the laboratory. Samples were air-dried and analyzed in the laboratory for soil pH with Coleman pH meter using soil "saturation extract". (Soil-water, 1:1 ratio, w/vol) and soil – potassium chloride ratio 1:2:5 w/vol. Total N was determined by the semi-micro kjeldahl digestion method as modified by Tel and Rao (1982), while available P was determined by the Bray and Kurtz No. 1 method (Tel and Rao, 1982). Exchangeable K was extracted with neutral normal ammonium acetate buffered at pH 7.0. Potassium (K) in the extract was measured by flame photo-meter (Tel and Rao, 1982). Ca and Mg in the extract were determined by EDTA Complex metric titration (Tel and Rao, 1982).

Experimental Plot

The field was laid out in a randomized complete block design and replicated three (3) times. Each block measured $464m^2$ containing eleven (11) plots. The plots measured $5.0\ x\ 5.0\ m$ each. The cassava cuttings were spaced at $1.0\ x\ 1.0\ m$. The ten cassava varieties evaluated included 99/6012, 96/1632, TMS 30572, 98/0002, 91/02324, 98/2101, 97/3200, 94/0026, 96/1642, 97/0162 and local best (Efuwa) which served as the control. These varieties were evaluated for resistance to bacterial blight under natural infection.

Cultural Practices

The cassava cuttings were planted on the flat after clearing. Since cassava plants are sensitive to weed competition during the early part of their growth, manual weeding was done at 4, 8, 12 and 18 weks after planting (WAP). Observations on sprouting were carried out at 1, 2, and 3 (WAP). The number of sprouts per cutting was counted until fill or near 100% emergence (complete sprouting was calculated and numbers of nodes were counted). Initial plant growth vigour 3 WAP was rated on scale (modified from CIAT 1983).

Incidence of CBB

Incidence of CBB was recorded as the number of cassava plants showing leaf symptoms over the total number of plants per treatments multiplied by 100 (IITA 1990a).

$$\frac{Number\ of\ infected\ plants}{Total\ number\ of\ plants\ per\ treatment} \times 100$$

Severity of CBB

Severity scoring was done thrice, first at the beginning of rainy season, (May), second at the peak of rainy season (September) and third at the end of the rainy season (IITA 1990b).

The following scoring system was used.

0 = No symptoms observed.
1 = only angular leaf sprouting.
2 = Exclusive leaf blight, leaf wilt and defoliation and gum exudation on stems and petioles
3 = Extensive leaf blight, wilt and stem die-back
4 = Complete defoliation and stem die-back of lateral shoots.

Number of leaves

The total number of leaves was counted. This was carried out by counting the number of leaves per stem or per plant basis (IITA, 1983)

Number of branches

The total number of branches was counted at 3 and 6 months after planting (MAP)

Leaf Area
The leaf area was determined by tracing (graph) method.

Fresh tuber yield
`Tuberous roots are those that are thicker than 0.5cm to 1cm. If tuberous roots are formed, a separation of these can be done according to their diameter into small, intermediate, large classes (IITA, 1990a). Subsequently, fresh weight analysis was done on the basis of these individual classes.

Statistical Analysis
Data obtained were subjected to analysis of variance (ANOVA). The means of the treatments found to be significant were compared using New Duncan Multiple Range Test (NDMRT) according to procedures of statistical Analysis System (SAS, 1991). Correlation was also done to determine the relationship among parameters.

III. Results and Discussion

Incidence of CBB
The peak incidence period was maintained at 3AMP but declined at 6 MAP for virtually all the varieties except local best, TMS 30572 and 91/02324 (Table 1). For some others, no incidence of CBB was observed at 1 MAP. This was noted for 96/1632, 91/02324, 98/2101, 97/3200, 94/0026, 96/1642, 97/0162.

Table 1: Incidence of CBB on selected cassava varieties

Treatments	Incidence (%) Months after planting		
	1	3	6
Local best	43 ± 25^{a}	45 ± 13^{b}	42 ± 7^{b}
99/6012	20 ± 2^{b}	48 ± 6^{a}	46 ± 2^{a}
96/1632	5 ± 0^{b}	24 ± 7^{c}	0 ± 0^{d}
TMS 30572	5 ± 3^{b}	20 ± 4^{cd}	23 ± 3^{c}
98/0002	5 ± 1^{b}	17 ± 1^{cd}	4 ± 0^{d}
91/02324	0 ± 0^{b}	0 ± 0^{c}	4 ± 0^{d}
98/2101	0 ± 0^{b}	5 ± 1^{de}	4 ± 0^{d}
97/3200	0 ± 0^{b}	5 ± 1^{de}	4 ± 0^{d}
94/0026	0 ± 0^{b}	15 ± 1^{cde}	0 ± 0^{d}
96/1642	0 ± 0^{b}	5 ± 1^{de}	0 ± 0^{d}
97/0162	0 ± 0^{b}	4 ± 0^{de}	0 ± 0^{d}

MAP Months after planting
Means with same alphabets along the column are not significantly different from one another $P < 0.05$

Some fluctuations in incidence of CBB were noted at 1 MAP, 3 MAP and 6 MAP for local best, TMS 30572 and 91/02324, TMS 30572 maintained an increase in incidence from 1 MAP until 6 MAP while incidence increased between 1 Map and 3 MAP but declined at 6 MAP for local best. However, incidence of CBB was only observed at 6 MAP for 91/02324. On a general note, the incidence of CBB showed that 91/02324 and 97/0162 were more resistant while local best and TMS 30572 were susceptible to the disease.

Severity of CBB
Field observation of cassava varieties revealed the occurrence of bacterial blight, though the severity was mild. Significant difference $(p < 0.05)$occurred among varieties of severity of cassava bacterial blight (CBB) at one month after planting (1 MAP), 3 MAP and 6 MAP (Table 2). The highest severity was at 3 MAP then severity declined at 6 MAP for some varieties like 99/6012, 98/0002, 94/0026 and 96/1642. It was observed that there was significant increase in severity between 1 MAP and 3 MAP for these varieties but declined at 6 MAP. There was neither decline nor increase in severity between 3 MAP and 6 MAP for local best and TMS 30572. However, severity increased slightly between 3 MAP and 6 MAP for 91/02324, 97/3200.

Table 2: Severity of CBB selected cassava varieties

Treatments	Incidence (%) Months after planting		
	1	3	6
Local best	2 ± 0^{a}	3 ± 0^{a}	3 ± 0^{a}
99/6012	2 ± 0^{a}	3 ± 0^{bc}	1 ± 0^{c}
96/1632	1 ± 0^{c}	2 ± 0^{bc}	1 ± 0^{d}
TMS 30572	2 ± 0^{b}	3 ± 0^{ab}	3 ± 0^{b}
98/0002	2 ± 0^{a}	3 ± 0^{a}	2 ± 0^{c}
91/02324	1 ± 0^{c}	1 ± 0^{e}	2 ± 0^{c}

98/2101	1 ± 0^{c}	1 ± 0^{de}	2 ± 0^{d}
97/3200	1 ± 0^{c}	1 ± 0^{de}	2 ± 0^{d}
94/0026	1 ± 0^{c}	2 ± 0^{cd}	1 ± 0^{d}
96/1642	1 ± 0^{c}	2 ± 0^{cd}	1 ± 0^{d}
97/0162	1 ± 0^{c}	2 ± 0^{e}	1 ± 0^{d}

MAP Months After Planting

Means with same alphabets along the column are not significantly different from one another $p < 0.05$

The cassava varieties exhibited varying degrees of resistance to bacteria blight 94/0026 compared favourably with six other resistant varieties. The increase in severity and incidence of CBB with time (the beginning and peak of rainy season) observed for the varieties suggest that high rainfall favours the spread of the disease. This is in agreement with the findings of Hahn *et al.* (1989) and IITA (1990) who reported an increase in incidence and severity of CBB over a period of six months on both resistant and susceptible genotypes under similar environmental conditions. Results from this study show that incidence and severity of the disease decline at the end of the rains. These agree with the findings of Daniel and Boher (1985) who reported that in the absence of rainfall, the parasite *Xanthomonas camprestis pv. Manthotis* stop spreading in the tissues and the epiphytic populations disappear. The parasite can survive in stem and seed tissues and in plant debris which fall to the ground, but not in the soil. This observation however, negates the assertion of Parsley (1989) who reported that CBB is usually severe in grassland region where rainfall is barely sufficient with a long dry season of 5- 7 months and where cassava is grown mainly as a monocrop.

Branching and leaf development of various varieties

Significant differences were also observed for number of branches/leaves. The number of branches increased between 3 MAP and 6 MAP for all varieties except *98/0002* and 98/2101 which maintained the same number of branches at 3 MAP. TMS 30572 had the highest number of branches while *98/0162* had the lowest. The number of leaves also increased as the months increased. TMS 30572 also recorded the highest number of leaves. A reduction in the number of leaves was noted between 3 MAP and 6 MAP for *91/02324* as shown in Table 3. The result from number of branches and leaves suggests that the number of leaves produced is determined by the number of branches, hence the higher the number of branches, the higher the number of leaves. The implication of this is that TMS 30572 can be grown as a dual purpose variety: for leaf production (which is used as vegetable by many African families) and tuberyield.

Table 3: Branching and leaf development of selected cassava varieties

Treatment	**Branches**		**Leaves**		**Leaf Area (cm^2)**		
	3 MAP	**6 MAP**	**3 MAP**	**6 MAP**	**1 MAP**	**3 MAP**	**6 MAP**
Local best	24 ± 3^{b}	37 ± 3^{b}	318 ± 16^{b}	592 ± 51^{b}	27 ± 3^{c}	65 ± 3^{d}	76 ± 3^{d}
99/6012	9 ± 4^{cd}	10 ± 5^{cde}	73 ± 44^{c}	139 ± 87^{d}	70 ± 1^{c}	79 ± 2^{d}	139 ± 1^{d}
96/1632	13 ± 6^{d}	18 ± 8^{cd}	140 ± 59^{c}	281 ± 142^{ab}	43 ± 2^{c}	53 ± 2^{d}	72 ± 2^{c}
TMS 30572	44 ± 5^{b}	74 ± 8^{a}	619 ± 74^{b}	1264 ± 124^{a}	37 ± 2^{c}	73 ± 2^{d}	101 ± 2^{d}
98/0002	2 ± 0^{b}	2 ± 1^{c}	34 ± 14^{c}	70 ± 26^{d}	17 ± 1^{b}	21 ± 1^{d}	97 ± 2^{d}
91/02324	2 ± 0^{b}	2 ± 0^{e}	26 ± 4^{c}	51 ± 9^{d}	63 ± 2^{c}	104 ± 3^{b}	113 ± 3^{c}
98/2101	12 ± 1^{d}	16 ± 2^{cd}	103 ± 10^{c}	211 ± 15^{d}	84 ± 1^{c}	157 ± 3^{d}	169 ± 3^{c}
97/3200	4 ± 0^{b}	7 ± 1^{de}	46 ± 7^{c}	84 ± 14^{d}	34 ± 2^{c}	41 ± 2^{d}	76 ± 2^{c}
94/0026	10 ± 2^{ab}	17 ± 4^{cde}	146 ± 33^{c}	300 ± 63^{ab}	51 ± 2^{d}	103 ± 5^{b}	162 ± 2^{b}
96/1642	15 ± 3^{b}	24 ± 3^{c}	66 ± 71^{b}	433 ± 182^{bc}	55 ± 2^{d}	63 ± 1^{d}	170 ± 1^{c}
97/0162	1 ± 0^{b}	2 ± 1^{e}	32 ± 16^{c}	54 ± 23^{d}	40 ± 2^{e}	60 ± 1^{b}	124 ± 2^{d}

Means with same alphabets along the column are not significantly different from one another $p < 0.05$

Leaf area continued to enlarge with time (1, 3 and 6 MAP). This confirms earlier findings by Hunt *et al* (1997) that cassava leaves produced at different times throughout the plant's lifecycle appear to be different in size. The process of producing new leaves, the time required for expansion and rate of leaf growth can be dependent on the genetic makeup of the plant.

Effect of bacterial blight on yield and yield component

The yield components, number of roots, weight of roots, above-ground biomass and fresh tuber yield

showed significant difference (Table 4). Number of small roots ranged between 14 for 97/3200 and 41 for 96/1642; variety 99/6012 recorded the highest number of large roots($33.83tha^{-1}$). Weight of small roots ranged between $2.24tha^{-1}$ for 94/0026 and $10.44tha^{-1}$ for 97/3200. Highest above-ground biomass yield was also recorded by 99/6012 as compared to 97/3200 that gave the lowest yield of$3.6tha^{-1}$. The highest total yield was recorded by 94/0026. Local best and five others gave yield comparable to 94/0026.

Table 4: Yield and Yield Components

Treatment	Root Number		Root Weight Yeild		Above Ground	Total
	Root No. Small (no/ha)	Root No. Large (no/ha)	Root Weight Small (no/ha)	Root Weight Large (no/ha)	Above ground Biomass (t/ha)	Total Yield (t/ha)
Local best	25 ± 5^{bc}	72 ± 8^{b}	1.08 ± 0.4^{abc}	26.92 ± 5.8^{bc}	8.24 ± 5.3^{ab}	28.00 ± 5.5^{bd}
99/6012	15 ± 2^{c}	120 ± 7^{a}	0.84 ± 0.2^{abc}	33.88 ± 2.0^{b}	23.32 ± 2.0^{b}	34.72 ± 2.1^{b}
96/1632	20 ± 3^{bc}	77 ± 4^{b}	0.88 ± 0.5^{abc}	29.08 ± 2.0^{ab}	12.92 ± 1.8^{b}	29.96 ± 2.4^{b}
TMS 30572	34 ± 1^{ab}	72 ± 4^{b}	1.44 ± 0.4^{bc}	26.28 ± 1.8^{bc}	10.68 ± 2.0^{b}	27.72 ± 0.8^{bd}
98/0002	20 ± 5^{bc}	76 ± 2^{b}	0.92 ± 0.6^{aba}	24.92 ± 2.0^{b}	8.8 ± 1.2^{cb}	25.88 ± 2.2^{b}
91/02324	25 ± 3^{bc}	65 ± 2^{b}	1.16 ± 0.3^{ab}	17.08 ± 2.7^{c}	8.28 ± 0.9^{abc}	18.24 ± 3.0^{b}
98/2101	19 ± 2^{c}	40 ± 3^{b}	0.84 ± 0.2^{ab}	13.72 ± 2.0^{c}	4.8 ± 0.6^{bc}	14.56 ± 2.0^{b}
97/3200	14 ± 2^{c}	33 ± 3^{c}	0.44 ± 0.4^{a}	10.00 ± 1.7^{b}	3.6 ± 0.6^{b}	10.44 ± 1.4^{b}
94/0026	29 ± 11^{abc}	81 ± 14^{b}	2.24 ± 0.8^{b}	32.8 ± 01.7^{b}	21.6 ± 15.5^{b}	35.04 ± 2.5^{b}
96/1642	41 ± 2^{b}	81 ± 3^{b}	1.92 ± 0.9^{ab}	30.4 ± 0.6^{bc}	10.92 ± 0.9^{ab}	32.32 ± 0.7^{b}
97/0162	19 ± 2^{c}	79 ± 2^{c}	0.52 ± 0.3^{bc}	26.12 ± 0.9^{bc}	7.08 ± 2.0^{ab}	26.8 ± 0.6^{b}

Means with same alphabets along the column are not significantly different from one another $p < 0.05$It could be deduced therefore that when the improved get adapted to the agro-ecology, their resistance tend to diminish.

Yield / Yield Components

Negative correlation exists between disease incidence / severity and yield. This implies that increase in incidence / severity amounts to yield reduction, while decrease in incidence / severity enhances high yield. Therefore, yield could be improved by selecting for disease resistant varieties.

Table 5: Relationship Between Incidence / Severity and Yield

Trt	Local Best		99/6012		96/1632		TMS 30572		98/0002		97/02324		98/3200		97/3200		94/0026		96/1642		97/0162	
	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev
Yield	0.213	0.079	0.057	0.103	0.094	0.160	0.397	0.195	0.080	0.150	0.02	0.092	0.030	0.082	0.138	0.023	0.041	0.120	0.031	0.14	0.051	0.171

Among the varieties studied, 94/0026 had the highest fresh tuber yield. This is not unexpected, being that this variety had very low susceptibility to the disease with very mild spotting on the leaf. This is in line with the study by Boher *et al.* (1995) who showed that the leaf is the target of the bacterial disease which in severe cases lead to defoliation. This premature defoliation results in loss of tuber yield. The result from this study has established the fact that cassava bacterial blight is one of the major disease that pose a serious threat to the increased production of cassava (IITA 1990b). Yield reduction up to 92% in susceptible cultivars have been reported (Umemure and Kawano, 1983).This study also revealed some resistant varieties such as 98/2101, 97/3200 and 91/02324 which had low yield. This suggest that the improved varieties are becoming less resistant to cassava bacterial blight (Osakwe *et al.*, 2000). It is important to note that there was no significant correlation between leaf area and yield. This result could be attributed to the spotting, wilting and distortion on the leaves of the varieties evaluated. These symptoms caused by bacterial disease altered the plant's leaf surface area which may have affected light interception to an appreciable extent and hence reduced photosynthetic activity. According to Hunt *et al* (1997), a plant's total leaf surface area determines the maximum amount of photosynthetic product which it can produce. The observation made in this study with respect to leaf area negates the assertion of dale and Milthorpe (1983) who reported that leaf physiology is a significant factor controlling crop productivity which is particularly noticeable in cassava. Root number, weight and above-ground biomass had a significant positive correlation with yield. This suggests that the number and weight of the roots may affect yield to an appreciable extent.

Table 6: Relationship Between Some Parameters and Yield

	La 6 Map	**Rt No Sm**	**Rt No Lg**	**Rt Wt Sm**	**Rt Wt Lg**	**Above Ground Biomass**	**Total Yield**
La 6 Map							
Rt No Sm	0.293^{ns}						
Rt No Lg	0.181^{ns}	0.248^{ns}					

Rt Wt Sm	0.431^{*}	0.753^{***}	0.252^{ns}				
Rt Wt Lg	0.205^{ns}	0.287^{ns}	0.849^{***}	0.463^{***}			
Above Ground Biomass	0.143^{ns}	-0.048^{ns}	0.653^{***}	0.289^{ns}	0.732^{***}		
Total Yield	0.178^{ns}	0.334^{**}	0.836^{***}	0.508^{**}	0.992^{***}	0.73^{***}	

$* = p < 0.05$ $** = p = 0.01$ $*** = p < 0.001$, *Ns = Not Significant, LA = Leaf area,*
RT NO SM = Root Number (Small), RT NO LG = Root Number Large,
RT WT SM = Root Weight Small, RT WT LG = Root Weight Large,
MAP = Months After Planting

Another factor that could influence yield despite infection is the fact that cassava in the humid forest zone of Nigeria passes through three seasons in one life cycle. It is planted between April – September (rainy season) grows through October – March (dry season) and harvested between April – September of the following year (rainy season). This period of 12 months enables some varieties severely infected early in the growth cycle to recover and yield economically (IITA, 1990). In conclusion, this study has established that incidence and severity of CBB are both negatively correlated with tuber yield. It therefore suggests that farmers can use disease resistant varieties for enhanced tuber yield. Varieties 99/6012, 96/1632, 94/0026 and 96/1642 with high level of resistance are recommended for crop multiplication in humid rain forest zone of Nigeria. Other varieties such as TMS 30572, 96/1642 and 94/0026 were observed to have high foliage and tuber yield, thus serving a dual purpose.

References

[1]. Boher B and Agboli C A 1992. La bacteriose vasculaire du manioc au Togo. Characterization, repartition geographique et sensibilite varietale. *Agronomie Tropicale* 2: 131 – 136.
[2]. CIAT 1983. Centro International Agricultural Tropica. Morphology of the cassava plant. Study guide series O4EC 0.0.03 Columbi, pp 44. Dale, J.E. and Milthorpe (1983). The growth and functioning of leaves. Cambridge University press, Cambridge England. 79p
[3]. Daniel J F and Boher B 1985a Epiphytic phase of *Xanthomonas campestris PV Manthotis* on parts of cassava. Agronomie 5: 111 – 116
[4]. Daniel J F and Boher B 1985b Etude des modes de service de l'agent causal de la bacteriose vasculaire du manioc, *Xanthomonas campestris FV Manithotis.* Agronomie 5: 339 – 346
[5]. FAO 1984 FAO production book, 1984 pp. 115
[6]. Hahn S K 1984. Tropical root crops: their improvement and utilization. Conference paper 2, IITA Ibadan, Nigeria.
[7]. Hahn S K Isoba G G J Ikotun T 1989. Resistance breeding in root and tuber crops at the International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria, *Crop Protection* 8: 173.
[8]. Hunt L A Wholey D W and Cook J H 1977. Growth Physiology of Cassava (*Manihot escule ta Crantz).Field Crops Abstract 30*(2): 72 – 73.
[9]. IITA 1983 In Annual Report for 1978. International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria, 109 – 111
[10]. IITA 1990a Cassava in tropical Africa, A reference manual of tropical agriculture (IITA) Ibadan, Nigeria. pp. 174 – 176.
[11]. Omodiji M O Oyedokan, J E and Akinlosotu T A 1988 Diagnostic survey of cassava based farming system practices. Osun State. F.A.C.H. publication pp 51 – 54.
[12]. Osakwe J A Ikpe F N Adeniji M O and Folorunsho S O 2000. A rational utilization of scare planting material in cassava *Manihot esculenta crantz. India J. Agric. Sc.* 70 (11) 753 – 766.
[13]. Parsley G J 1989. Studies on the survival and transmission of *Xanthomonas campestris* on cassava seed. *Annals of Applied Biology.* 93:159 – 166.
[14]. Perreaux D H Marate H and Meyer J 1982. Identification of 3 (methhlthio). Propionic acid as blight inducing toxin produced by *Xanthomonas campestris PV manihotis Physiological Plant pathology* 20:313 – 319
[15]. Statistical Analysis System 1991. SAS/STAT users' guide version 6 fourth edi. Cary. VC: SAS Institute.
[16]. Tel, D. and P.V. Rao (1982): Automated and semi-automated methods for soil and plant analysis, IITA manual series No. 7. International Institute of tropical Agriculture, Ibadan, Nigeria.
[17]. Umemura Y and Kawano K 1983. Field assessment and inheritance of resistance and cassava bacterial blight. *Crop Science,23: 1 (*1127 – 1132)
[18]. Boher, B., & Agboli, C. A. (1992). La bacteriose vasculaire du manioc au Togo. Characterization, repartition geographique et sensibilite varietale. In *Agronomie Tropicale* (pp. 131 - 136).
[19]. Daniel, J. F., & Boher, B. (1985a). Epiphytic phase of Xanthomonas campestris PV Manihotis on parts of cassava. In *Agronomie 5:* (pp. 111-116).
[20]. Daniel, J. F., & Boher, B. (1985b). Etude des modes de service de I' agent causal de la bacteriose vasculaire du manioc, Xanthomonas campestris FV manihotis. In *Agronomie 5:* (pp. 339-346).
[21]. Hahn, S. K. (1984). Tropical root crops: their improvement and utilization. *Conference paper 2,* (p. 173). IITA Ibadan, Nigeria.
[22]. Omodiji, M. O., Oyedokan, J. E., & Akinlosoatu, T. A. (1988). *Diagnostic survey of cassava based farming system practices.* Osun State: F.A.C.H. publication.
[23]. Perreaux, D. H., Marate, H., & Meyer, J. (1982). Identification of 3 (methhlthio). Propionic acid as blight inducing toxin produced by Xanthomonas campestris PV Manthotis Physiological plant Pathology. 20:313-319.