RESISTANCE SCREENING FOR WHITEFLY INFESTATION IN A RANGE OF CASSAVA GENOTYPES ESTABLISHED IN MULTILOCATIONAL TRIALS OF IITA IN NIGERIA

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Introduction

Cassava mosaic begomovirus(es) vectored by the whitefly *Bemisia tabaci* (Gennadius), is considered the most damaging pathogen of cassava. Host plant resistance (HPR) to the insect vector is one of the virus resistance mechanisms (Rusell, 1978). However, HPR is rare in cultivated crops (Belloti and Arias, 2001) and large-scale screening of cassava cultivars for whitefly resistance is limited. Therefore, this study was conducted at different agroecological zones in Nigeria to investigate resistance to the whitefly vector in some cassava elite clones.

Materials and Methods

Twenty two new cassava elite clones and eight other genotypes (Table 1) were assessed for whitefly infestation (Winf.) in 1999/2000 and 2000/2001 cropping seasons in experimental fields of IITA, Nigeria (Figure 1). The experimental design was a randomised complete block, replicated four times at the different locations. Five plants were randomly selected in each plot. Vector population was recorded as whitefly number/plant. Incidence of cassava mosaic disease (CMD) was also calculated on plant basis as described by Ariyo *et al.* (2002). ANOVA was performed using SAS, version 8.2 (2002) . Duncan multiple range test was thereafter conducted to group the elite clones.

Table 1. Mean populations of adult whiteflies across locations

Cassava geno	Mean VAB	Sample size (N)#	SE (±)
96/1439	9.7a	898	2.4
95/0166	9.0a	904	2.3
91/02324	8.5b	914	2.4
96/1708	8.4b	900	2.6
96/1642	7.9c	908	2.2
96/0249	7.6d	902	2.3
92/0325	7.6d	907	2.3
96/1087	7.4e	910	2.3
96/1569	7.4e	908	2.6
96/1632	7.0f	914	2.4
96/1565	7.0f	910	2.4
92/0326	6.9f	892	2.4
96/0191	6.9f	911	2.3
TME-1	6.5g	900	2.3
82/00058	6.2h	903	2.6
96/00037	6.0i	907	2.3
96/0860	5.9i	913	2.3
96/0035	5.9i	907	2.2
96/1039	5.8i	900	2.2
96/0304	5.4j	914	1.6
96/0160	5.4j	904	2.6
96/0016	5.3j	905	2.3
4(2)1425	5.1k	905	2.4
96/1613	5.0l	906	2.3
96/0590	4.7m	902	2.4
96/0529	4.3n	900	2.5
Isunikankiyan	4.1n	896	2.3
96/1800	3.9o	901	2.6
96/1089A	3.6o	904	2.4
TMS 30572	3.0p	864	2.1

#Sample size, which is the total number of plants sampled per genotype, per month within each location, for the two trials (2 years, 1999/2000 and 2000/2001). SE=standard error between means of whitefly counts obtained between 1 and 6 months after planting. geno = genotypes, VAB = vector abundance

Infectivity index

Infectivity index (InFec.), a product of mean Wlfn. recorded at each site and the incidence of CMD recorded each month was calculated, providing a measure of overall inoculum pressure in each locality (Otim – Nape *et al.*, 1998). The assumption in this case was that whitefly population in each locality has the same vector efficiency.

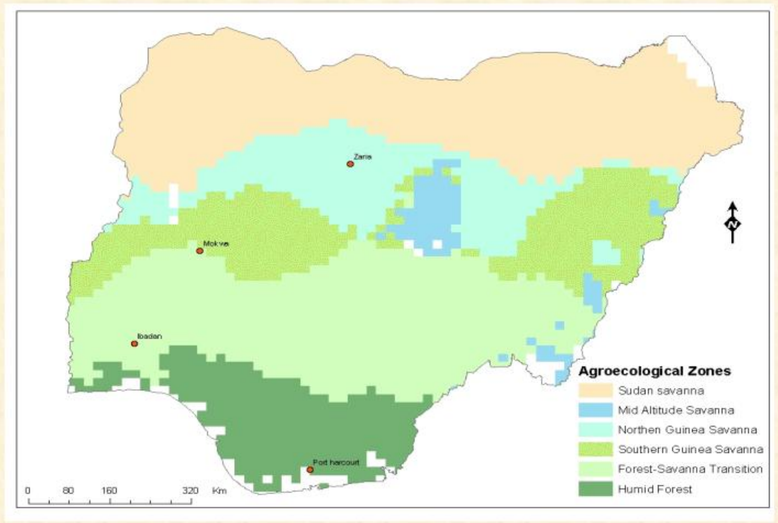

Figure 1. Selected locations in different agroecological zones of Nigeria for screening cassava genotypes for resistance to whitefly infestation

Results

Evaluation of whitefly infestation across locations

Highly significant differences ($p < 0.01$) in WInf. between the cassava clones and locations were observed. Whiteflies were observed on the underside of cassava leaves (Plate 1). Clones 96/1439 & 95/0166 significantly supported highest vector infestation/plant, 9.7 ± 2.4 & 9.0 ± 2.3, respectively, across locations (Table 1). Clones 96/1800, 96/1089A & TMS 30572 significantly supported lowest WInf.

Plate 1. Whiteflies on the underside of a cassava leaf

Monthly fluctuation of whitefly infestation and Infectivity index at different locations

The peaks of WInf. and InFec. were observed 2 months after planting (MAP) across cassava genotypes in Ibadan and Onne. The peak was less pronounced in Zaria (Fig. 2).

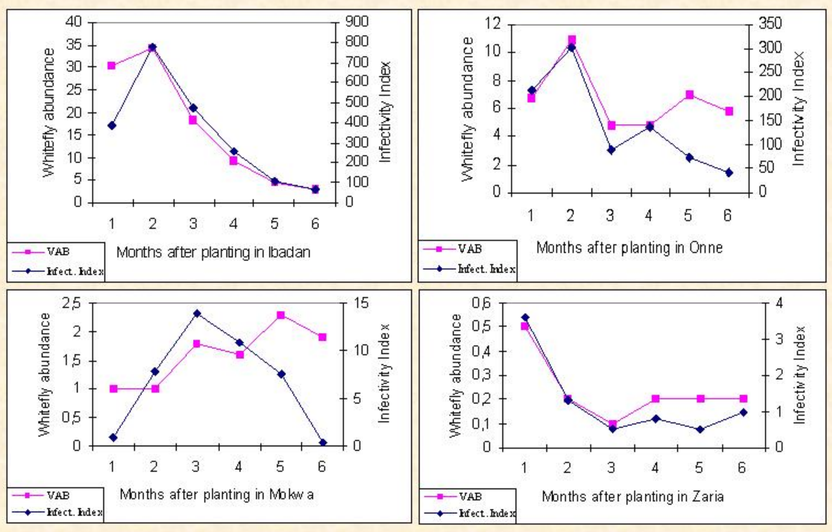

Figure 2. Relationship between whitefly abundance and Infectivity index across cassava genotypes, where VAB = whitefly abundance, Infect. Index = Infectivity Index

Differential levels of whitefly resistance in representative cassava genotypes

In Ibadan, highest WInf. was observed in 96/1439 (64.4 whiteflies/plant), 1 MAP and dropped significantly with time (Table 2). Plants of 91/02324 (1.8 whiteflies/plant) and 96/0304 (1.5) recorded relatively low values for WInf., 3 MAP in Mokwa (Table 2). Also, clones 96/0529, 96/1800 with purple petioles & ISU (red petiole) supported low WInf. However, the petiole colour of 96/1089A & TMS 30572 was light green. Contrarily, these clones were observed with less luxuriant growth and canopy spread compared to clones 96/1439, 91/02324, 95/0166, which supported high WInf.

Table 2. Monthly variation in whitefly infestation (representative cassava genotypes)

Cassava geno.	Months after planting in Ibadan*						Mean	S.E. (±)
	1	2	3	4	5	6		
96/1439	64.4	62.3	24.9	14.2	8.9	3.0	29.6	9.9
91/02324	47.4	50.0	25.0	11.2	5.8	7.3	24.5	7.3
96/0304	2.3	22.2	13.0	6.9	1.3	1.1	13.0	4.0
82/00058	30.0	33.5	22.1	11.0	2.5	1.9	16.8	5.0
Isunikankiyan	26.6	23.8	5.7	2.9	2.3	1.3	10.4	4.2
96/1089A	16.2	14.7	5.9	5.4	4.2	3.4	6.6	2.1
	Months after planting in Mokwa*							
96/1439	1.0	1.0	3.6	2.0	2.7	3.6	2.3	0.4
91/02324	1.0	1.0	1.8	2.0	1.9	3.1	1.8	0.3
96/0304	1.0	1.0	1.5	1.5	2.2	1.4	1.4	0.2
82/00058	1.0	1.0	2.0	1.7	2.7	1.2	1.6	0.3
Isunikankiyan	1.0	1.0	0.7	2.1	2.4	1.0	1.4	0.3
96/1089A	1.0	1.0	1.4	0.8	2.5	1.3	1.4	0.2
	Months after planting in Onne*							
96/1439	2.3	17.9	4.8	7.9	77	2.1	7.1	2.2
91/02324	7.8	7.2	6.9	6.0	11.6	2.8	7.1	1.1
96/0304	9.8	8.9	5.7	5.9	11.0	2.1	7.2	1.2
82/00058	8.2	10.5	3.2	4.9	6.1	5.9	6.5	1.0
Isunikankiyan	5.8	4.7	4.0	2.6	4.6	5.6	4.6	0.4
96/1089A	10.3	5.2	2.9	2.5	2.8	10.7	5.7	1.4
	Months after planting in Zaria*							
96/1439	0.4	0.1	0.1	0.1	0.2	0.1	0.2	0.1
91/02324	0.5	0.1	0.1	0.2	0.2	0.1	0.2	0.1
96/0304	0.4	0.1	0.1	0.3	0.1	0.0	0.2	0.1
82/00058	0.4	0.1	0.0	0.3	0.1	0.1	0.2	0.1
Isunikankiyan	0.3	0.2	0.2	0.4	0.1	0.2	0.2	0.0
96/1089A	0.5	0.2	0.2	0.3	0.2	0.1	0.3	0.1

where, * = mean monthly whitefly counts, S.E.=standard error between means, geno=genotypes

Discussion

Highly significant difference in WInf. between locations suggests influence of variation in climatic factors at different locations. WInf. peak observed in Ibadan 2 MAP coincided with a period of drop in mean monthly RF. Thus, reducing the possibility of the whiteflies been washed away with heavy rains. The significantly high mean WInf. in 96/1439 and 91/02324 could be due to their remarkable luxuriant growth, providing more new succulent leaves upon which vector fecundity can be enhanced (Fargette *et al.*, 1993). Besides, the green petiole colour of these clones is usually preferred to red-green petioles (Nair and Daniel 1983). Although, clones 96/1439 & 91/02324 with green petioles supported high WInf., plants of 96/1089A and TMS 30572 with light green petioles did not. Hence, some inherent factors, other than the morphological characters might be responsible for resistance to WInf. Therefore, an understanding of the nature of genes that confer resistance in these resistant genotypes is suggested to be explored. This will enhance quick selection of whitefly resistant germplasm and isolation of genes conferring whitefly resistance.

References

Ariyo, O. A., Dixon, A. G. O. and Atiri, G. I. (2002). *Arch. of Phytopath. and Plant Protection* 35:23-30

Belloti, A. C. and Arias, B. 2001. *Crop Protection* 20:813 –823

Fargette, D., Jeger, M., Fauquet, C. and Fishpool L. D. C. 1993. *Journal of Phytopathology* 84(1):91-98.

Nair, N.G. and Daniel, R.S. 1983. *Journal of Root Crops* 9(1-2):45-49.

Otim-Nape, G. W., Thresh, J. M., Bua, A., Baguma, Y. and Shaw, M. W. 1998. *Annals of Applied Biology* 133: 415 – 430.

Russell, G. E. 1978. Butterworts, London. pp. 209 - 229.

SAS, (Statistical Analytical Institute); 2002. Version 8.2. SAS Institute Inc., Cary, NC, USA.