WILD *Manihot* SPECIES AS A SOURCE FOR RESISTANCE TO ARTROPOD PESTS OF CASSAVA

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INTRODUCTION

Wild *Manihot* species are a wealth of useful genes for the cultivated species *Manihot esculenta* Crantz but their use in regular breeding programs is restricted by the long reproductive breeding cycle of cassava and linkage drag associated with the use of wild relatives in crop improvement. Wild relatives of cassava are important sources of genes for resistance to pests and diseases and longer shelf life. The only source of dramatically delayed PPD has been identified in an inter-specific hybrid between cassava and *Manihot walkerae* (CIAT 2003). A unique source of resistance to the cassava hornworm was also identified in 4th backcross derivates of *M. glaziovii* (Chavarriaga et al 2004). This work reports preliminary results of a study directed to identify useful genes for pest and disease resistance in wild species of *Manihot* and to develop low cost marker tools for their rapid introgression into cassava.

In a first phase of the project, evaluations of two Brazilian wild species (*M. flabellifolia* y *M peruviana*) (Mueller) and commercial genotypes of *M. esculenta* were conducted in a screen house to identify levels of resistance to the mite, *Mononychellus tanajoa,* the mealybug, *Phenacoccus herreni* and, the whitefly *Aleurotrachelus socialis* Bondar (Fig. 1). In addition studies were conducted to develop a quick method to detect whitefly resistance, based on the number of eggs oviposited per female on a specific genotype. This will be a useful tool to evaluate resistance/susceptibility in a great number of progenies from interspecific crosses between wild *Manihot* species and *M. esculenta* genotypes.

Figure 1. Mites, Mealybugs and Whiteflies

MATERIALS AND METHODS

A. Screening for Natural Resistance:

Plants of the genotypes CMC-40, MECU-72 from *M. esculenta*; MFLA 444-002 from *M. flabellifolia* and MPER 417-0003, MPER 417-005 from *M. peruviana*, were propagated. Four, 40 day old plants of each genotype, were placed individually in a fine nylon mesh screened cage. Infestations of *M. tanajoa*, *P. herreni* and *A. socialis*, obtained from greenhouse/screenhouse colonies were introduced on individual plants on the following manner:

1. Upper leaves of the five genotypes were infested with 200 *M. tanajoa* mites.
2. *P. herreni* ovisacs were placed in the axil of upper plant leaves. First damage/population evaluation were made 10 days after infestation and continued every 10 days for eight weeks.
3. The five genotypes were infested with 200 recently emerged (12h) *A. socialis* adults. Evaluations were initiated after five days and continued every ten days, for eight weeks.
4. Population and damage scales were employed for evaluating each of the pest species. These scales are based on a 1 to 6 rating where 1 indicate no pest population and no plant damage; while 6 indicate very high pest population (I.e. for whiteflies 6=> 4.000 nymphs and pupae per leaf) and severe damage.

B. Rapid Selection Method for *A. socialis*:

Ten plants of progenies from the interspecific cross of *M. esculenta* x *M. flabellifolia*, CW235-72, CW259-3, CW259-43, CW257-10, CW258-17, CW259-10 and commercial cassava variety, CMC-40 were sown in plastic pots. Five plants of each genotype, at 40 days after germination, were placed in nylon mesh cages (1mx1mx1m) for whitefly (*A. socialis*; obtained from CIAT reared colonies) infestation.

Ovipositional preferences was determined by introducing ten pair of recently emerged *A. socialis* adults (reared on CMC-40)into small leaf cages (2.5 cm diameter x 2.0 cm depth) attached to the underside of upper leaves of each genotype (Fig. 2A). After five days adults were removed and the number of eggs oviposited recorded (Fig. 2B). Eggs were allowed to hatch and nymphs allowed to develop for ten days in order to estimate development to the third instar (Fig. 2C).

Figure 2. Figure 2. A: Small leaf cages B: Eggs and C: Nymphs of *A. socialis*

RESULTS

M. tanajoa: The mite infestation on the *M. flabellifolia* genotype (MFLA 444-002) and the *M. peruviana* genotypes (MPER 417-003 and MPER 417-005) were significantly different (Tukey P< 0.005) from the *M. esculenta* genotypes (MECU-72 and CMC-40). Leaf damage on the three wild *Manihot* genotypes was significantly different from the two *M. esculenta* genotypes (Fig. 3).

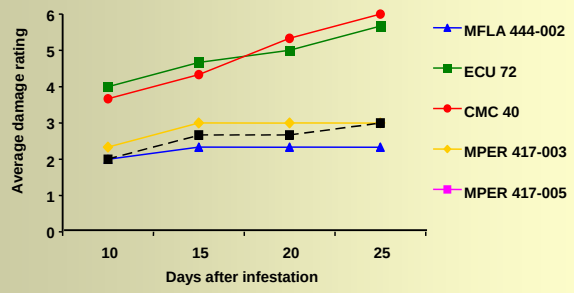


Figure 3. Mite (*Mononychellus tanajoa*) damage ratings on wild *Manihot* genotypes and commercial cultivars during a 25 day sampling period

***P. herreni*: MPER417-003 and MFLA 444-002 presented the lowest mealybug infestation levels (Fig. 4). MPER417-003 had the lowest damage levels, suggesting possible resistance to this species.**

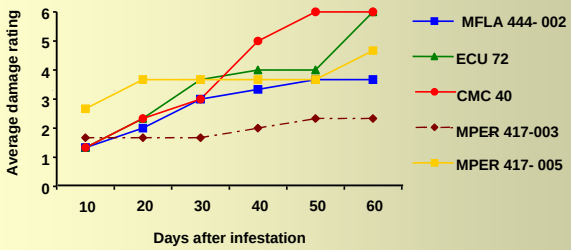


Figure 4. Mealybug (*Phenacoccus herreni*) damage ratings on wild *Manihot* genotypes and commercial cultivars (CMC-40, MEcu-72) during a 60 day infestation

***A. socialis*: Accessions from the wild *Manihot* species, MPER417-003, MPER417-005 and MFLA444-002 all resulted in highly significant damage and population differences from the *M. esculenta* genotype CMC-40 (Tukey P< 0.005). These results indicate a high degree of resistance in the wild genotypes. MECU-72 was previously selected as resistant to *A. socialis* and this resistance is confirmed in these results (Fig. 5).**

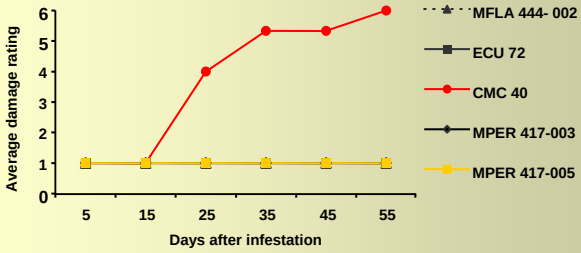
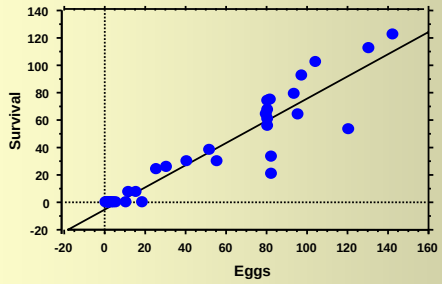


Figure 5. Whitefly (*Aleurotrachelus socialis*) damage ratings on the wild *Manihot* genotypes (MFLA 444-002, MPER 417-003) and *M. esculenta* cultivars CMC-40 and MEcu-72 during a 55 day infestation period.

Rapid Selection Method for *A. socialis*

Development of *A. socialis* nymphs on cassava (interspecific progeny) genotypes displayed a behaviour similar to the ovipositional rates on these genotypes. The genotype CW235-72 had the least development of nymphal stages, owing to very low ovipositional rates. CMC-40 and CW259-43 displayed the highest percentage differences (42% and 30% respectively) in nymphal development when compared to the initial ovipositional rates (Fisher's P< 0.05). The genotypes CW235-72 and CW257-10 showed the least differences (0% and 17% respectively) between oviposition and nymphal development.

A regression analysis was performed in order to obtain a correlation between oviposition and nymphal development (3rd instar) of *A. socialis* on progeny of *M. esculenta* x *M. flabellifolia* (Fig. 6). Results show a 87% correlation in development of the nymphal stages and number of eggs oviposited. It can therefore be concluded that number of eggs oviposited on a given genotype can be used as an indicator of the preference/resistance of *A. socialis* for that genotype.



Y = -1.875 + .786 * X; R^2 = .873

Figure 6. Correlation between oviposition and nymphal survival of the whitefly, *Aleurotrachelus socialis* on progeny of *M. esculenta* x *M. flabellifolia*

CONCLUSIONS AND ONGOING RESEARCH

- The wild species genotypes MFLA444-002, MPER 417-003 and MPER417-005 displayed intermediate level of resistance to *M. tanajoa* and high levels of resistance to *A. socialis*.
- The genotypes MFLA 444-002 y MPER 417-003 showed moderate levels of resistance to *P. herreni.*
- The ovipositional rate (No. of eggs) of *A. socialis* on a given genotype is a good indication of the level of resistance of determined genotype.
- A project to develope low cost marker tools for accelerated marker-aided introgresion of useful genes into cassava gene pools in being funded under the GCP(Generation Challenge Programme) with participation of IARCs (CIAT, Cali, Colombia) and NARS in Brazil (CNPMF/ EMBRAPA Cruz das Almas, Bahia) and in Africa in Ghana (CRI, Kumasi), Nigeria (NRCRI, Umadike) and Uganda (NAARI, Namulonge).

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