ADAPTATION OF BIOTYPE "B" OF *Bemisia tabaci* TO CASSAVA

A. CARABALI[ab], A.C. BELLOTTI[a], & J. MONTOYA-LERMA[b]

[a]Centro Intrnacional de Agricultura Tropical (CIAT), A.A. 6713, Cali, Colombia
[b]Departamento Biología, Universidad del Valle, Cali, Colombia

INTRODUCTION

Bemisia tabaci (Fig. 1A) is considered one of the most important pests in tropical and subtropical agriculture, as well as in production systems in glasshouses (Perring, 1996). Since the 1980s, it has caused considerable economic losses in the southern United States, Mexico, Venezuela, the Eastern Caribbean Basin, and Central and South America due to its proven efficiency as a virus vector, together with damage caused by direct feeding and excretion of honeydew (Oliveira et al., 2001).

To date, a total of 24 biotypes have been identified in different regions of the world, which suggests that *B. tabaci* may be a complex of species and biotypes undergoing continuous evolutionary changes (Perring, 2001). Biotype B of *B. tabaci* is a recognized pest in cassava crops in Asia and Africa, where it transmits the African cassava mosaic virus (ACMV) (Fig. 1B).

Fig. 1. A: Biotype *"B" B. tabaci* B: Cassava leaves afected by ACMV

Although in the Americas it has been postulated that the absence of ACMV is related to the inability of *B. tabaci* to colonize properly this crop. Hence, the potential adaptation is considered a threat for cassava production in these areas. This work departed from the hypothesis that *B. tabaci* could become gradually adapted to cassava *(Manihot esculenta)*.

MATERIALS AND METHODS

The process of adaptation was initiated from a highly susceptible host (*Phaseolus vulgaris*), phylogenetically distant from *M. esculenta*, passing through two intermediate hosts, *Euphorbia pulcherrima* and *Jatropha gossypiifolia*, both Euphorbiaceae, susceptible to *B. tabaci* but phylogenetically close to *Manihot* (Fig. 2). To reach cassava cultivar MCol 2063 "Secundina," well known by its susceptibility to the whiteflies *Aleurotrachelus socialis* and *B. tuberculata* was selected as the final host.

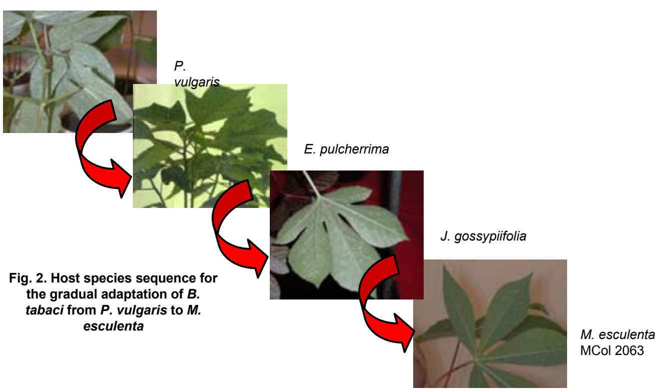

Fig. 2. Host species sequence for the gradual adaptation of *B. tabaci* from *P. vulgaris* to *M. esculenta*

Parameters of the life history of biotype B on *M. esculenta* with individuals previously established on *P. vulgaris, E. pulcherrima* and *J. gossypiifolia*

In order to determine the relative importance of the hosts up to the time of their adaptation on *M. esculenta*, population parameters were estimated and evaluated for each specimen of biotype B on *M. esculenta*, reared previously on (a) *P. vulgaris* and passed sequentially to (b) *E. pulcherrima* and (c) *J. gossypiifolia*. In the first case, plants of *E. pulcherrima* were placed in cages and infested with recently emerged adults of Biotype B of *B. tabaci*, coming from the strain established on *P. vulgaris* for five generations. Similarly, after five generations on *E. pulcherrima*, individuals of *B. tabaci* were used to infest plants of *J. gossypiifolia* and lastly, fifth generation individuals coming from *J. gossypiifolia*, were used to infest plants of MCol 2063.

Longevity and fecundity, forty pairs of recently emerged *B. tabaci* coming from each of the three sequences of hosts, were individualized in clip cages, and placed on the underside of the leaves of plants (MCol 2063). Every 48 h the adults were removed to a new area of the leaf. Fecundity was estimated by counting the number of eggs oviposited by the female every 48 h, while longevity was the maximum time (days) that a female lived.

Development time, rate of survival and proportion of females, fifty adults of biotype B, coming from *P. vulgaris*, *E. pulcherrima* and *J. gossypiifolia* on the underside of MCol 2063 leaves. After 6 h the adults were removed, and 200 eggs were selected at random for rearing to adulthood. In each case, the development time from egg to adult, the survival rate of the immature stages, and the proportion of females emerged were recorded.

Demographic parameters, the data on the development time of the immature individuals were combined with experimental data from the reproduction to produce life tables and, used to calculate the demographic parameters defined by Price (1975): 1) Net reproduction rate (Ro), 2) generational time (T), and 3) intrinsic rate of population growth (r_m).

RESULTS AND DISCUSSION

Biology and demographic parameters of biotype B of *B. tabaci* on *M. esculenta* (MCol 2063), coming from three hosts *P. vulgaris, E. pulcherrima* and *J. gossypiifolia*

The average longevity of the females of biotype B was significantly higher in females coming from *E. pulcherrima* (5.6 days). The highest oviposition rate (2.64 eggs/female/2 days) was found in females coming from *J. gossypiifolia*, being significantly higher than that of females coming from the other two hosts (Table 1).

Table 1. Longevity (days), fecundity (eggs) and oviposition rate (eggs/female/2 days) of biotype B of *B. tabaci* on *M. esculenta* (MCol 2063) with populations coming from three hosts (n=40).

	Host of Origin		
Average Parameter	***J. gossypiifolia***	***E. pulcherrima***	***P. vulgaris***
Longevity	**3.25 b**	**5.6 a**	**3.1 b**
Fecundity	**8.6 a**	**7.65 a**	**1.82 b**
Oviposition rate	**2.64 a**	**1.36 b**	**0.58 c**

Averages followed by different letters in the columns differ significantly (Kruskal-Wallis P< 0.0001, followed by Student-**Newman-Keuls P< 0.05).**

Individuals of biotype B coming from *J. gossypiifolia* took 44.4 days to develop on *M. esculenta*, a significantly shorter time, by about 6 days, as compared with *E. pulcherrima* and *P. vulgaris* (Table 2). On the other hand, it was shown that the highest survival rate (27.5) was reached by individuals grown on *J. gossypiifolia* compared with 3.0 and 2.0 % when came from *E. pulcherrima* and *P. vulgaris*, respectively.

Table 2. Development time, survival and proportion of females of individuals of biotype B of *B. tabaci* on *M. esculenta* coming from *J. gossypiifolia*, *E. pulcherrima* and *P. vulgaris* (n=200).

	Host of Origin		
Parameter	***J. gossypiifolia***	***E. pulcherrima***	***P. vulgaris***
Development time (days)*	**44.4 b**	**50.6 a**	**49.5 a**
Survival rate (%)	**27.5 a**	**3.0 b**	**2.0 b**
Proportion of females (%)	**50.9**	**50**	**50**

Averages followed by different letters in the columns differ significantly.* Kruskal-Wallis P< 0.0001, followed by Student-Newman-Keuls P< 0.05.ᶲ χ^2, 2 df, P< 0.0002, followed by Student-Newman-Keuls P< 0.05.

Based on the net reproduction rate (Ro), it was possible to determine that after one generation, on average, the populations of Biotype B can multiply 11.6 times (individual/individual) on cassava when they come from *E. pulcherrima* (Table 3). A generation time of Biotype B of *B. tabaci* on *M. esculenta* is 44.76 days when the populations come from *J. gossypiifolia*.

Intrinsic growth rates (r_m) revealed *a* higher population growth on *M. esculenta* when coming from *J. gossypiifolia***,** exceeding those from *E. pulcherrima* by 8.3% and up to 58.3% for those from *P. vulgaris.*

Table 3. Demographic parameters for individuals of biotype B of *B. tabaci* on *M. esculenta* coming from *J. gossypiifolia*, *E. pulcherrima* and *P. vulgaris* (n=200).

	Host of Origin		
Parameter	***J. gossypiifolia***	***E. pulcherrima***	***P. vulgaris***
Ro	**8.63**	**11.6**	**1.82**
T	**44.76**	**56.03**	**51.3**
r_m	**0.048**	**0.044**	**0.02**

Population parameters suggested an increase in the capacity for adapting to the cultivars of *M. esculenta*, favored by the influence of phylogenetically related hosts such as *J. gossypiifolia*. This might act as gradual points in which insect populations undergo an increase in their biotic potential, thereby facilitating their adaptation to *M. esculenta* (Fig. 3). Indeed, this fact constitutes one of the principal findings of this study, as it makes possible determine the adaptive capacity of biotype B on *M. esculenta*, which, according to Costa and Russell (1975), represents a "dead host", in the Americas.

Fig. 3. Populations of biotype B on jatropha and cassava

CONCLUSIONS

Based on the previous findings it is possible to state that in Colombia, *M. esculenta* is a potential host for biotype B of *B. tabaci*.

REFERENCES

Costa, A.S., Russell, L.M. 1975. Failure of *Bemisia tabaci* to breed on cassava plants in Brazil (Homoptera: Aleyrodidae). Cienc. Cult. Sao Paulo 27, 388-390.

Oliveira, M.R.V., Henneberry, T.J., Anderson, P., 2001. History, current status, and collaborative research projects for *Bemisia tabaci.* Crop Prot. 20, 709-723.

Pering, T.M., 1996. Biological differences of two species of *Bemisia* that contribute to adaptative advantage, In: Gerling, D., Mayer, D. (Eds.), *Bemisia*: 1995 Taxonomy, biology, damage, control and management. Intercept Ltd., Andover, Hants, UK, pp. 3-16.

Perring, T.M., 2001. The *Bemisia tabaci* species complex. Crop Prot. 20, 725-737.

Price, P., 1975. Insect ecology. John Wiley & Sons, New York. 514 pp.

March 8-14, 2004 – CBN-VI