OUTPUT IV. GLOBAL IPM NETWORKS AND KNOWLEDGE SYSTEMS DEVELOPED

Sub-output 1. Systemwide Project On Integrated Sustainable Management Of Whiteflies As Pests And Vectors Of Plant Viruses In The Tropics. (P. Anderson)

Emerging diseases and pests

The emergence and dissemination of whitefly-transmitted geminiviruses in the Americas

The proliferation and rapid dissemination of whitefly-transmitted viruses of important food and industrial crops in Latin America, have been the consequence of dramatic changes in traditional cropping systems. Bemisia tabaci has been shown to transmit at least 20 different gemiiviruses that affect different commercial and basic food crops in Latin America. Morales and Anderson (2001) reviewed the existing knowledge on the emergence of Bemisia-transmitted geminiviruses in cotton, beans, tomatoes and other vegetables over the last 30 years, and offered several explanations for the inability to control the whitefly/geminivirus problem in Latin America, despite the availability of different whitefly control tactics.

First, all the national agricultural research institutions of Latin America have suffered significant losses of experienced personnel and operational resources. This loss in human resources and technical assistance occurs at a time when Latin American farmers are trying to grow new crops they are unfamiliar with. There are no interdisciplinary research teams currently investigating the whitefly/geminivirus problem as a complex. Most of the information generated on *B. tabaci* has been produced by entomologists, without much consideration for the role of this species as a virus vector. Most of the research on tropical geminiviruses has been conducted in temperate countries by molecular biologists. Young agricultural scientists from developing countries are being trained in advanced laboratories on the use of molecular techniques. As a result, the complex interactions among geminiviruses, whitefly biotypes and new cropping systems are often ignored.

Whitefly and geminivirus specialists usually select one or few crops to work with, either because of their mandate or because of economic circumstances (i.e. availability of research funds to study geminiviruses of economically important crops, such as tomato). Thus, the cropping systems' vision required to solve these complex pest problems, is lacking. Another negative factor has been the "projectization" of agricultural research and lack of operational funds for germplasm improvement, which has prevented the development of both long-term epidemiological studies, and development of geminivirus-resistant plant germplasm. Of all the crops currently affected by WTGs in Latin America, only the common bean, and to a much lesser extent tomato, have been genetically improved for geminivirus resistance. The development of pest and disease-resistant cultivars that eliminate or reduce the need for frequent pesticide applications, is a must for the implementation of sustainable agricultural practices. The development of transgenic plants possessing resistance to geminiviruses is a promising but costly undertaking, which should not exclude the application of conventional breeding methods to combat whitefly-transmitted geminiviruses.

The control of whitefly-transmitted geminiviruses requires the concerted participation and close collaboration of molecular biologists, virologists, entomologists, plant breeders, agronomists, epidemiologists, economists, sociologists and concerned administrators, if we expect to defeat the "pest of the century".

Morales, F.J., and P.K. Anderson. 2001. The emergence and dissemination of whitefly-transmitted geminiviruses in Latin America. Archives of Virology 146: 415-441.

***Bemisia afer sens. lat.* outbreak in the Americas**

The first outbreak of *Bemisia afer sens. lat.* in an agricultural situation in the Americas is reported. *B. afer* was discovered on sweetpotato (I*pomoea batatas* Lam.) in the Cañete Valley in the central coast of Peru.

Bemisia tabaci (Gennadius) was reported on sweetpotato (*Ipomoea batatas* Lam.) from the central coast of Peru in the late 1980s, noting that it was not a significant pest (Redolfi 1989, cited in Nuñez 1995). However, in the 1997-1998 agricultural season, unusually large populations of *Bemisia tabaci* were reported to be significantly affecting sweetpotato yields in the coastal valleys of Peru (Valencia et al. 2000). In August of 2000, P. Anderson (CIAT) made a field visit to the Cañete Valley, approximately 100 km south of Lima, with Cristina Fonseca of the International Potato Center (CIP) and Ing. Jose M. Valencia of the Cañete Experimental Station, to explore the problem. The nymphs that were actively reproducing on sweetpotato were *Bemisia*. However, the adult whiteflies, which were abundant on sweetpotato and pepino (*Solanum muricatum* Ait.) were larger and whiter (more *Trialeurodes*-like) than typical for *Bemisia tabaci*. Thus, nymphs were collected from sweetpotato for taxonomic verification.

Whitefly nymphs were slide-mounted and tentatively identified as *Bemisia afer*, by P. Hernandez at the International Center for Tropical Agriculture (CIAT) in Cali, Colombia. The identification was verified as *Bemisia afer sens. lat.*, by J. Martin at the Natural History Museum in London, UK (BMNH). Voucher specimens were deposited in the BMNH.

This is the first outbreak we have observed of *Bemisia afer sens. lat.* in an agricultural situation in the Americas. *B. afer* has been recorded from Egypt, Greece, Sicily, the Middle East, the Ethiopian region, Comoro Islands, India, Pakistan, New Guinea, Fiji, Tonga (Martin 1987), Sudan, Sierra Leone, Cote d'Ivoire, Nigeria, Niger, Chad, Cameroon, Congo, Zaire, Uganda, Rhodesia, Malawi, South Africa (Bink-Moenen 1983), and Australia (Martin 1999). *B. afer* has hitherto been considered as a common and widespread pest species, feeding on a wide variety of plants (Martin 1987).

In Belize in 1994 and 1996, plants of a papaveraceous host, *Bocconia frutescens* L., were found to be colonized by very large populations of a species of *Bemisia* with highly characteristic puparia. This belongs to *B. afer sens. lat.*, but the puparial characteristics fall outside those normally observed in areas of the world where *B. afer* is widespread. While studying the whitefly collection of the US National Museum of Natural History (housed at USDA, Beltsville, Maryland), Martin noted a small number of *Bemisia afer*-group samples that are likely to be

conspecific with the samples from *B. frutescens* in Belize. These samples were either field-collected in, or intercepted by US quarantine authorities from Honduras, Mexico and El Salvador. Quoted host plants include *Pouteria* sp (Sapotaceae), *Hibiscus* sp (Malvaceae), *Origanum* sp (Labiateae), *Ficus* sp or spp (Moraceae), *Serjania* sp (Sapindaceae) and *Psidium guajava* (Myrtaceae). There are also two additional slides from Belize in BMNH, one from an unidentified woody vine and matching the *Bocconia* puparia, and the other (possibly a smooth-leaf form of the same species) from a wild cassava plant growing on a forest track remote from agriculture. From this material, it appears that this taxon is widespread and oligophagous in Central America.

Bink-Moenen (1983) proposed the synonymy of *Bemisia hancocki* Corbett (1936) with *B. afer* (Priesner and Hosny 1934). This synonymy was based on examination of one badly damaged syntype of *B. afer* deposited in the BMNH. Based on Martin's subsequent examination of a complete syntype puparium of *B. hancocki* deposited in USNM, this synonymy may have been premature. However, with the considerable degree of puparial morphological plasticity now becoming evident within the *B. afer* group, formally resurrecting *B. hancocki* could cause further nomenclatural confusion at this point.

B. hancocki was first described from cotton (*Gossypium hirsutum* L.) in Uganda by Corbett (1936). Mound (1965) examined *B. hancocki* specimens from cotton, peanut (*Arachis hypogaea* L.), and *Vigna (catjang) unguiculata* (L.) Walp., and noted *B. hancocki* collections from cassava (*Manihot esculenta* Cranz) in Sierra Leone, Nigeria, Cameroon, and Sudan. He further described the variation in the puparial morphology of *B. hancocki* as being almost as great as that of *B. tabaci*. Personal observations made by Martin, Estrella Hernández-Suarez (ICIA, Canary Islands, Spain) and by Raymond Gill (CDFA, Sacramento, USA) indicate that the *B. afer* group actually displays considerably greater puparial morphological variation than does *B. tabaci* and its forms/biotypes.

Although specimens from the *B. afer* group have been previously discovered in non-agricultural situations in the Americas, this is the first report of a *Bemisia afer sens. lat.* outbreak on an important crop host in the New World. The extent of *B. afer* dissemination and its host-associations in Peru need to be investigated. Furthermore, the taxonomy of *Bemisia afer* and *Bemisia hancocki* should be re-visited and, the possible role of *B. afer* in virus transmission needs to be clarified.

References

BINK-MOENEN, R.M. 1983. Revision of the African whiteflies. Monografieen van de Nederlandse Entomologisch Vereniging No. 10. 211 pp.

CORBETT, G.H. 1936. New Aleurodidae (Hem.). Proceedings of the Royal Entomological Society of London (B) 5: 18-22.

MARTIN, J.H. 1987. An identification to common whitefly pest species of the world (Homoptera, Aleyrodidae). Tropical Pest Management 33: 298-322.

MARTIN, J.H. 1999. The whitefly fauna of Australia (Sternorrhyncha: Aleyrodidae): a taxonomic account and identification guide. CSIRO, Canberra, Australia (CSIRO Entomology Technical Paper No. 38).

MOUND, L.A. 1965. An introduction to the Aleyrodidae of Western Africa (Homoptera). Bulletin of the British Museum (Natural History) 17: 115-160.

NUÑEZ, E.Y. 1995. Reporte de Perú. CEIBA (Honduras) 36: 157-162.

PRIESNER, H., AND M. HOSNY. 1934. Contributions to a knowledge of the white flies (Aleurodidae) of Egypt (III). Bulletin Ministry of Agriculture of Egypt, Technical and Scientific Service 145: 1-11.

VALENCIA, L., N. MUJICA, AND F. CISNEROS. 2000. Informé de Perú. pp. 194-198. *In*: IX Taller Latinoamericano y del Caribe sobre Mosca Blanca y Geminivirus. MIDA-IDIAP, Panama.

ANDERSON, P.K., J.H. MARTIN, P. HERNANDEZ, and A. LAGNAOU. 2001. *Bemisia afer sens lat.* (Homoptera: Aleyrodidae) outbreak in the Americas. Florida Entomologist 84(2): 316-317.