1931, los cocoteros enanos rojos y verdes fueron sembrados en el Jardín Botánico de Lancetilla cerca de Tela, Honduras, y los dos colores de cocoteros enanos (y muy pocos amarillos también) se encuentran en Honduras (5). En Colombia y Ecuador estos enanos rojos y verdes se conocen con el nombre de 'Manila' (2).

En 1963, 100 nueces de distintas variedades fueron introducidas a Costa Rica desde la India (6). No se sabe qué cantidad de plantas germinó o sobrevivió, pero si estos cocoteros todavía existen y pueden encontrarse, serán una fuente de polen útil para la futura producción de cantidades experimentales de híbridos F_1 de cocoteros. Un tipo *(spicata)* de esta introducción debe ser fácilmente distinguida por su apariencia característica de inflorescencia que no tiene ramas.

Resumen

Los cocoteros de Costa Rica 'Atlántico Alto' y Pacífico Alto' son de los tipos 'Niu kafa' y 'Niu vai' respectivamente. Las diferencias en tipo de palma y tipo de fruto se enumeran en el presente trabajo.

La presencia de la variedad 'Pacífico Alto' en Barra Colorado en la Costa Atlántica, y 'Atlántico Alto' de Nicaragua, se debe a la ruta de transporte entre San Juan del Norte y San Juan del Sur que se realizaba en el siglo pasado.

Una discusión de las variedades enanas recién introducidas a Costa Rica se presenta en este trabajo.

Agradecimiento

Esta información se publica por los autores con el permiso de sus respectivas organizaciones.

14 de marzo de 1978.

D. L. RICHARDSON*

H. C. HARRIES**

E. BALSEVICIUS***

* Palm Research Program, Compañía Bananera de Costa Rica, Golfito, Costa Rica.

** Research Department, Coconut Industry Board P. O. Box 204 Kingston, Jamaica.

*** Asociación Bananera Nacional (ASBANA), Apartado 6504, San José, Costa Rica.

REFERENCIAS

1. BRUMAN, H. J. Some observations on the early history of the coconut in the New World. Acta Americana 2: 220-243. 1944.
2. HARRIES, H. C. Coconut varieties in America. Oleagineaux 26. 235-242. 1971.
3. ———————. The Cape Verde region (1499 to 1549); the key to coconut culture in the Western Hemisphere? Turrialba 27: 227-231. 1977.
4. ———————. The evolution, dissemination and classification of *Cocos nucifera* L. Botanical Review 44:
5. PERMAR, J. H. Catalog of plants growing in Lancetilla Experimental Garden. San Pedro Sula (Honduras). Tela Railroad Co. 1945. 37 p.
6. PIERIS, W. V. D. Introduction and exchange of coconut germplasm 1959-1966. *In* Third Session of the FAO Technical Working Party on Coconut Production, Protection and Processing. Jogjakarta, Indonesia. FAO PL: CNP/68/3, 1968. pp. 1-29.
7. ROMNEY, D. H. Central America. *In* Coconut Breeding; Yearly Progress Report of the FAO *ad hoc* Coconut Breeders' Consultative Committee. Rome, FAO. 1969. pp. 6-8.
8. SALAS, J. A. *et al.* (En preparación). Anillo Rojo de cocoteros de Costa Rica.

Beetle vectors of Cowpea Mosaic Virus in Costa Rica

Sumario. Se probó la capacidad de nueve especies de escarabajos para transmitir un tipo de Cowpea Mosaic Virus de Costa Rica, estrechamente relacionado serológicamente al CPMV-Arkansas. Se logró la transmisión del virus con **Ceratoma ruficornis** (el vector más eficiente), **C. atrofasciata, Gynandrobrotica variabilis, Diabrotica adelpha,** y **Epilachna varivestis**. Esta es la primera demostración de que G. variabilis y C. atrofasciata tienen la capacidad de transmitir el CPMV.

Introduction

Cowpea Mosaic Virus (CPMV) is one of the most importand pathogens of cowpea *(Vigna unguiculata)* in Costa Rica, Cuba, Nigeria, Puerto Rico and Trinidad (1, 2, 7, 8).

Bettles are the only known vectors of cowpea mosaic virus and play an extremely important role in its dissemination. With the exception of a single species, *Epilachna varivestis* Muls, which belongs to the family Coccinellidae, all of the known vectors of CPMV are species of the family Chrysomelidae. The Chrysomelid species reported as vectors are: *Cerotoma trifurcata* Forst., *C. ruficornis* Oliv., *Diabrotica balteada* Lec., *D. adelpha* Har., *D. undecimpunctata howardi* Barber, *D. virgifera* Lec., *Acalymma vittatum* F., *Ootheca mutabilis* Sahld and *Systena* sp (3).

The transmission of CPMV by beetles is a complex biological phenomenon, the mechanism of which is not yet understood. The ability of the beetle vectors to transmit the virus varies from one species to another (3).

This work was conducted to test various beetle species for their ability to vector a CPMV type from Costa Rica closely related serologically to CPMV- Arkansas.

Materials and methods

Beetles were collected in cowpea field plots in Turrialba during August and September, 1977. They were held for a period of 24 hours without food, then allowed an acquisition feeding period of 24 hours on CPMV-infected plants. The insects were then placed individually on healthy plants (cv. V-5 Moh) and were

Table 1.—Species of insects tested, number of individuals used of each species, transmission and percentage of transmission of Cowpea Mosaic Virus (CPMV) by different insects Turrialba, Costa Rica, 1978.

Species	Nº of insects used[1]	Transmission	% of Transmission
Ceratoma ruficornis	28	25/28[2]	89,2
Ceratoma atrofasciata	6	14/25	56,0
Gynandrobrotica variabilis	18	11/45	24,4
Diabrotica adelpha	5	2/9	22,0
Epilachna varivestis[3]	6	4/21	19,0
Epilachna varivestis[4]	11	0	0
Colaspis sp	13	0	0
Systena sp	10	0	0
Nodonota sp.	12	0	0

1/ Some of the beetles were used in transmission tests several times due to the scarcity of members of their species

2/ Number of successful transmissions over number of transmission tests.

3/ Adults.

4/ Larvae

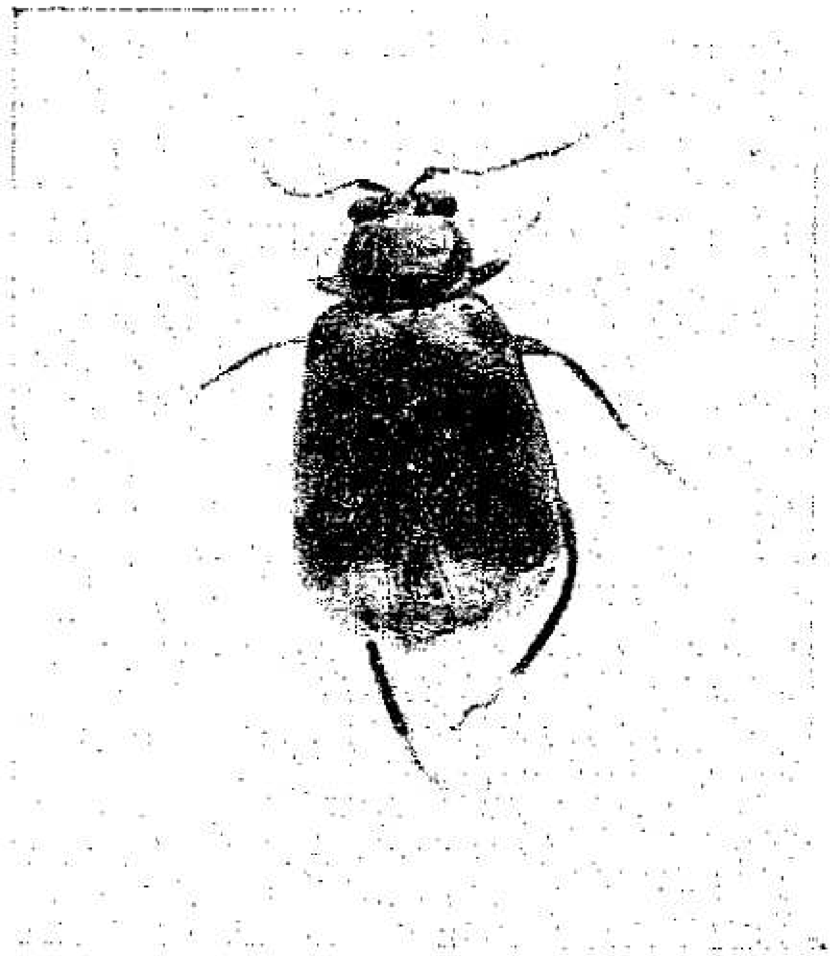

Fig. 1.—*Ceratoma atrofasciata Jacoby vector of cowpea mosaic virus in Costa Rica*

confined by cylindrical metal mesh cages. Once the beetles had fed (approximately 24 hours later), the cages and beetles were removed from the plants. The plants were tested serologically 15 days later for the presence of virus using the Ouchterlony double diffusion test.

The beetles used in the tests are listed in Table 1 which summarizes the results obtained.

Results and discussion

As shown on Table 1, transmission did not occur with *Nodonota* sp., *Systena* sp., *Colaspis* sp., nor with larvae of *E. varivestis*. The other species were able to transmit CPMV with varying degrees of efficiency. The most efficient vector was *C. ruficornis* (Oliv.) subsp. *rogesi* Jac followed, in order of decreasing efficiency, by *C. atrofasciata* (Fig. 1) and *G. variabilis* (Fig. 2), *D. adelpha*, *E. varivestis* and *D. balteata*.

As in Puerto Rico, Trinidad and Cuba (7, 2, 8), *C. ruficornis* is the principal vector of CPMV in Costa Rica. Levels of transmission by *Cerotoma ruficornis* were similar to those reported by Dale in Trinidad (2). The low levels of transmission of CPMV by *D. balteata* were similar to the results of González[1] but not to those of Jansen and Staples (5), who demonstrated

Fig. 2.—*Gynandrobrotica variabilis Jacoby vector of cowpea mosaic virus in Costa Rica.*

1/ González, C. Unpublished thesis. University of Costa Rica.

levels of 100%. However instead of individual beetles, they used groups of five insects in their transmission studies.

Jansen and Staples (6) demonstrated transmission of CPMV (severe strain) by larvae and adults of *E varivestis* In the present work, no transmission by larvae took place and only a relatively low level of transmission occurred using adults Fulton and Scott (4) showed transmission of CPMV-Arkansas at levels near 100 per cent with adults of *E varibestis*. The differences between the results of this work and the results mentioned above may be due to the different conditions under which tse experiments were carried out to the small number of insects used in this work

Gynandrobrotica variabilis and *Cerotoma atrofasciata* had not been reported as vectors of CPMV; this is the first demonstration of their ability to transmit the virus *

March 25th, 1978

RODRIGO VALVERDE**
RAUL MORENO***
RODRIGO GAMEZ**1/

* This research was partly financed by a research grant from Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT) de Costa Rica

** Laboratorio de Virología Universidad de Costa Rica San José, Costa Rica

*** Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba Costa Rica

1/ Rodrigo Gámez is a scientific fellow of CONICIT

REFERENCIAS

1 CHANT, S. R. Viruses of cowpea, *Vigna unguiculata* L. (Walp) in Nigeria. Annals of Applied Biology 47(3):565-572 1959.

2 DALE, W. T. The transmission of plant viruses by biting insects with particular reference to cowpea mosaic Annals of Applied Biology 40:384-392 1952.

3 FULTON, J P, SCOTT, H A and GAMEZ, R. Beetle transmission of legume viruses. *In* Bird, J. Maramorosch, K Eds Tropical Diseases of Legumes New York, Academic Press, 1975 pp 123-131

4 ———— and SCOTT H. A Bean rugose mosaic and related viruses and their transmission by beetles Fitopatología Brasileira (2):9-16 1977.

5 JANSEN, W. P. and STAPLES, R. Specificity of transmission of cowpea mosaic virus by species within the subfamily Galerucinae. Family Chrysomelidae Journal of Economic Entomology 61(2):365-367 1970

6 ———— and STAPLES, R. Transmission of cowpea mosaic virus by the Mexican bean beetle. Journal of Economic Entomology 63(5):1719-1720 1970.

7 PEREZ, J. E. and CORTES-MONLLOR, A A mosaic virus of cowpea from Puerto Rico Plant Disease Reporter 54(3):212-216 1970.

8 KVICALA, B. A., SMRZ J and BLANCO, N. Una virosis del caupi transmitida por un escarabajo en Cuba Plant Protection Bulletin (FAO) 21(2):27-29 1973

Compatibilidade da mandioca com cuatro especies selvagens de *Manihot* nativas do Brasil central

Resumo. No presente trablaho obteve-se hibridos férteis entre mandioca, ***Manihot esculenta*** Crantz, e as especies selvagens; ***M. anomala*** **Pohl, *M. oligantha*** **Pax subsp *nesteli*, *M gracilis*** **Pax, and *M. zehntneri*** **Ule** As citadas especies selvagens apresentaram meioses regulares, particularmente quanto a formaças dos 18 bivalentes A anafase I foi normal com distribuiçao de 18 cromossomos para cada polo Nao foi observada nenhuma separaças retardado dos bivalentes bem como restituiçao nuclear O polen destas especies selvagens mostrou-se moderadamente viavel

Interspecific hybridization had been tried frequently by breeders for the incorporation of useful characters from wild species into cultivated crops In cassava, a number of cases have been reported where the parental species were the tree-like forms, *M glaziovii* and *M dichotoma* (17) Two cases involving herbaceous species have been reported with *M saxicola* (2) and *M melanobasis* (8) as parents.

In our program of collection and evaluation of genetic resources of wild cassava at the Instituto de Ciencias Biologicas, Gioania, four wild species were shown to have high protein content, low HCN content, and were adapted to drought conditions (14, 15, 16) These species were screened for compatibility with cassava, and were investigated cytogenetically

Materials and methods

Four *Manihot* species: *M anomala* Pohl, *M. oligantha* Pax *emend* Nassar subp *nesteli*, *M. gracilis* Pax, and *M. zehntneri* Ule were collected from different localities of Goias state Seeds, cuttings, or the whole plant were planted. When plants flowered, crosses and reciprocal crosses were carried out between cassava *cv* 'Catelo' and the four wild species. Cytological investigations to study chromosome behaviour during meiosis were performed as follows: Inflorescences were fixed in a mixture of three parts absolute alcohol and one part propionic acid for 24 hours The propionocarmine technique of Swaminathan *et al.* (20) was used to make smear preparations of anthers. Chromosome configurations in metaphase I, chromosome distribution in anaphase I, and tetrad formation were observed. Pollen viability was determined by the acetocarmine and iodine stain technique Five hundred pollen grains of each species were examined

Results

Table 1 presents the mean number of seeds obtained from croses between cassava and each wild species of *Manihot* Means were calculated on the basis that *Manihot* species have trilocular ovaries, and each loculus contains a single seed Every pollinated flower, therefore, is able to produce three seeds