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A SURVEY OF BANANA DISEASES IN SUCKER PROPAGATED PLANTATIONS IN GRETE

by
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Summary. The choice of large size suckers for planting material in establishing plantations in Crete, provides the means of dissemination of several and diverse diseases. The most prevalent nematode species inhabiting the root system of banana (*Musa* AAA *cavendish* sub group: Dwarf Cavendish) in Crete is the root-knot nematode *Meloidogyne javanica*, which occurred in nearly 95% of the sampled sites. Two other nematode species, *Helicotylenchus multicinctus* and *Pratylenchus goodeyi*, were found in 28% and 18%, respectively, of the banana plantations. Nematode-infested banana roots were frequently in a general state of decay especially when the roots were also concomitantly infected by soil-borne fungi and/or bacteria. Several species of soil-borne fungi were isolated from necrotic tissues that in order of frequency of occurrence are: *Acremonium* sp. 24%, *Rhizoctonia solani* 12%; *Fusarium oxysporum* 12%; *F. solani* 6%; *Phytium* sp. 4%; *Fusarium compactum* 3%; and *Cylindrocarpon* sp. 3%. Pectinolytic bacteria, *Erwinia* spp. and *Pseudomonas* sp., were also consistently isolated from nematode-infected plants. Symptoms of virus infections were occasionally observed in the sucker planting material and referred to a strain of Cucumber Mosaic Virus (CMV).

Banana (*Musa* AAA *cavendish* sub group: Dwarf Cavendish) is the most important subtropical fruit tree in Crete. About 800 ha along the coastal areas of the island are devoted to this crop, which is grown in screenhouse, under plastic sheets and used for the internal market. In the subtropical climate of Crete bananas are subject to infection by pathogenic nematodes and fungi (Sikora and Schlosser, 1973; Pyrowolakis, 1979). There is little information about the specific identity of phytonematodes, fungi and other pathogens which infect bananas in Crete. A survey was carried out in May 1990 and September 1991 on 60 banana plantations of the island to determine the most common nematodes, fungi, bacteria and viruses infecting bananas. The results of this survey are reported in this paper.

Materials and methods

Sixty samples from 28 locations in the most representative banana-growing areas of the island were collected in May 1990 and September 1991. Five liters of soil, together with roots, were taken from the rhizosphere of 10 plants randomly selected within each plantation. Samples were taken always within 30-90 cm distance from the pseudostem. Nematode specimens were extracted from soil and from root tissues by centrifugation method, fixed in hot 4% formaldehyde + 1% propionic acid, processed to glycerine on permanent slides and identified on the basis of their morphological characters using a compound microscope.

Root segments were surface sterilized and placed in water agar plates and incubated at 22±2 °C for 10 days. The mycelia developed from root tissues were then transferred to new agar-potato sucrose plates for fungus indentification which was made from monoconidial cultures ten days later. Isolations for bacteria were made on nutrient agar-glucose medium and species identification made by classical bacteriological procedures. Banana leaves with virus symptoms were also collected and sap extracted from those was used to inoculate test plants. Viruses were identified on the basis of host-range symptomatology, aphid transmission and serological tests.

Results and discussion

The plant parasitic nematode species inhabiting the root tissues of banana in Crete in order of frequency of occurrence are: *Melodogyne javanica* (Treub) Chitw. (95%), *Helicotylenchus multicinctus* (Cobb) Golden (28%) and *Pratylenchus goodeyi* Sher *et* Allen (18%).

The root system of banana plants infected with *M. javanica* (Figs. 1A-E) were heavily galled, the galls varying in size and occurring at root tips as well as along the root axis (Figs. 1B, D). Longitudinal sections of infected roots revealed the presence of numerous (10-40/g of roots) mature females and large egg-masses, with 400-1200 eggs, embedded in the tissues. Deteriorated galls were often

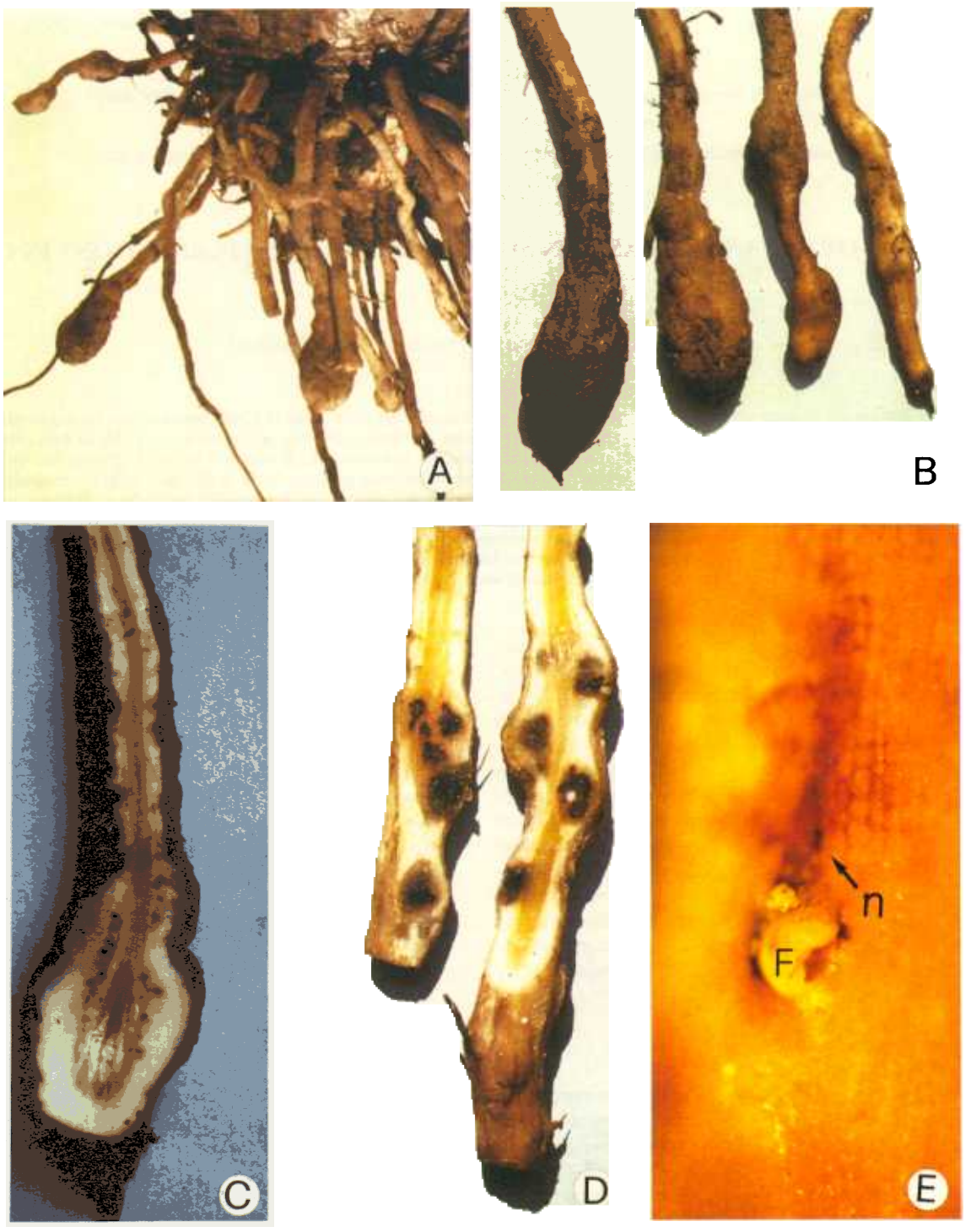

Fig. 1 - Banana roots heavily galled by the root-knot nematode *Meloidogyne javanica*: A, planting piece (sucker), note the absence of feeder roots; B, galls at root apex and along the axis; C and D, longitudinal section of galled banana roots showing nematode-females and egg-masses near the vascular root system; E, necrosis (n) on the root surface with an adult female (F), slightly protruding through root surface, starting oviposition.

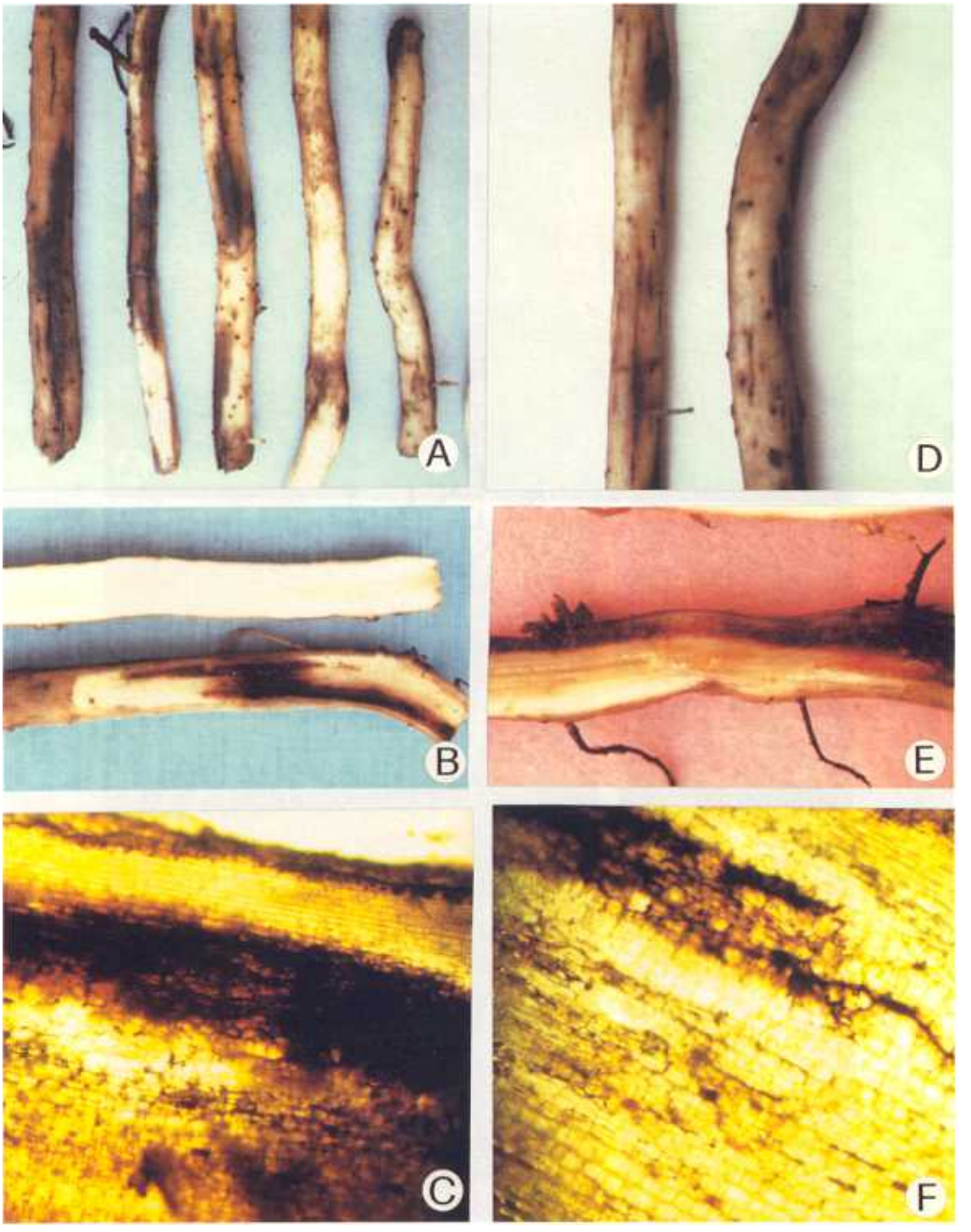

Fig. 2 - Banana roots attacked by the lesion nematode *Pratylenchus goodeyi* (A-C); and spiral nematode *Helicotylenchus multicinctus* (D-F): A, different stages of infection; B, longitudinal section of healthy and infected root; C, cortical necrosis; D and E, red-brown superficial and deep (cortical) necrosis of infected roots; F, cortical parenchyma with necrotic tissues induced by endoparasitic feeding activity of the spiral nematode.

Fig. 3 - Bacterial wilt on young and adult banana plants: A and B, cross and longitudinal sections of banana pseudostems infected by *Erwinia carotovora* showing internal symptoms; C, fruit-bearing plants likely to collapse as infection extends.

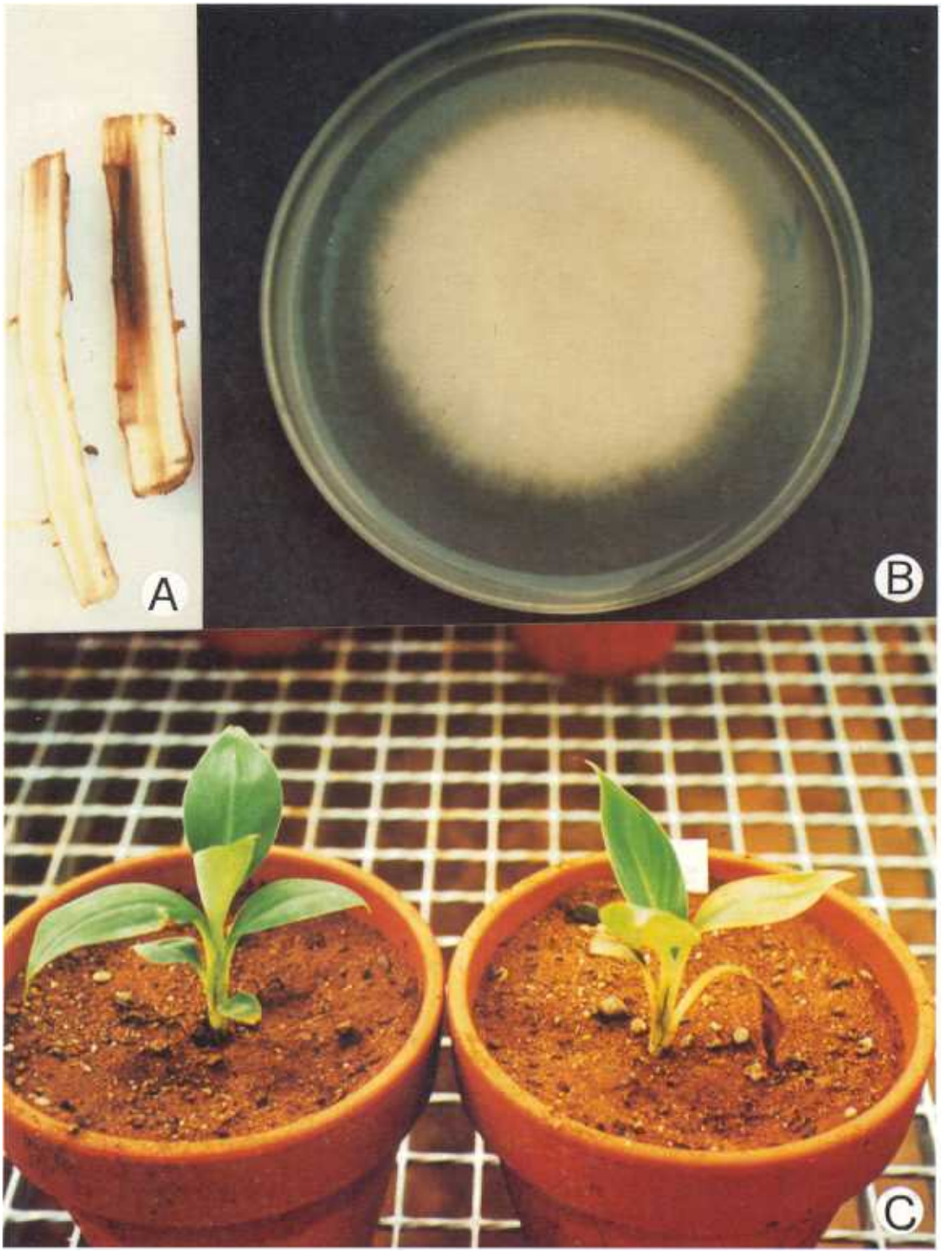

Fig. 4 - Cortical and vascular lesions of banana roots naturally infected by *Fusarium oxysporum* F. sp. *cubense* (A) and its growing mycelium in agar Petri dish in (B); C, susceptibility of banana *Musa* AAA Cavandish sub-group, Dwarf Cavandish plantlets (3 months old), to *F. oxysporum* F. sp. *cubense*, 15 days after inoculation.

Fig. 5 - Yellow pattern on banana leaves associated with infection of Cucumber mosaic virus.

found on feeder roots which were in an advanced state of decay. The galled tissues were also probably destroyed by the combined action of nematode feeding and the presence of other microrganisms. Although there were no symptoms expressed in the above ground parts of bananas, root systems were severely galled.

The spiral nematode, *H. multicinctus* (Figs. 2D-F), was less common than *M. javanica* in Crete and occurred in 28% of sampled areas with population densities ranging from 15-88 specimens/g of roots and 199-500 nematodes/250 ml of soil. Nematode infected roots had superficial lesions, which were red to brown in colour and did not penetrate deeply into the cortex. Although *H. multicinctus* has been reported to cause considerable root deterioration in many banana-growing areas of the world (Minz et al., 1960; Sikora and Schlosser, 1973), estimation of crop losses due to its attack is not available.

Pratylenchus goodeyi (Fig. 2A-C) is a migratory endoparasite with both juvenile and adult stages being invasive. It is widely distributed on banana in the Canary Islands, in every banana growing area in Kenya, and it has been indentified from banana in Tanzania (Machon and Hunt, 1985). It was in 18% of soil and root samples with populations densities ranging from 80-360 specimens/250 ml of soil and 6-77 specimens/g of root tissues. Nematode-infected roots showed extensive dark brown lesions (3-35 mm long) extending into the cortical parenchyma, but the central stele of the root was not invaded by the nematodes. *P. goodeyi* has been reported from Greece from soil around boxwood (Koliopanos and Kalyviotis-Gazelas, 1969) and from citrus, kenaf, and tomato in the Canary Islands, but its presence in the roots of these plants has not been confirmed (Machon and Hunt, 1985).

During our survey 15-20% of the samples from nematode-infected banana plants also showed above ground symptoms consisting of a rapid wilting and collapse of the leaves, and characteristic discoloration and blackening of suckers (Fig. 3). Pectinolytic bacteria, mainly of the genus *Erwinia* spp., were consistently isolated from the roots of diseased plants. *Pseudomonas* sp. was also present on isolation media on one occasion. On the basis of morphological, physiological and biochemical characters the *Erwinia* isolates were further identified as members of *E. carotovora* subsp. *carotovora* and *E. chrysanthemi*. *E. carotovora* has been involved in a soft-rot syndrome of banana plants in Israel (Vulckani and Zutra, 1967).

Several species of fungi were isolated from root tissues that in order of frequency of occurrence are: *Acremonium*

sp. (24%); *Rhizoctonia solani* Kuen, (2%); *Fusarium oxysporum* f. sp. *cubense* (E. F. Smith) Snyder *et* Hansen (12%); *F. solani* (Mart.) Appel *et* Wr. (6%); *F. compactum* (Wollenw.) Gordon (3%); *Phytium* sp. (4%) and *Cylindrocarpon* sp. (3%). To determine if the Cretan isolate of *F. oxysporum* (Fig. 4) was the pathogenic *forma specialis cubense*, pathogenicity tests were carried out in a glasshouse experiment using *in vitro-cultured* banana seedlings. Fifteen days after inoculation, young plants showed above ground symptoms, consisting of yellowing of the older leaves and vascular discoloration of the outer leaf sheaths (Fig. 4C). This disease had not been reported before our survey nor race indentification was assessed. *Fusarium* wilt (*F. oxysporum* f. sp. *cubense*) was relatively largely detected (12%) in the Island where we consider it was introduced with rhizomes imported from Israel, Egypt, and Morocco. The present report enlarges the geographical distribution of *Fusarium* wilt in the Mediterranean basin (Ploetz *et al.*, 1990).

A very limited presence of virus diseased plants was observed in our survey. Virus-infected banana plants were found only in a few plastic-houses at Malia (east part of the Island). The virus was identified as a strain of Cucumber Mosaic Virus (CMV) (Fig. 5), which has previously been reported in Crete (Avgelis, 1987). Our survey confirms that CMV on banana is limited in distribution, whereas it is widespread on vegetable crops in open fields of Crete.

In Crete, bananas are propagated by large size suckers that are removed from established mother plants. This cultural practice favours the dissemination of all the pathogens listed above with infected propagated material from unchecked mother plants. The adoption of micro propagative materials from *in vitro*-tissue cultures is the best sanitation practice to prevent the dissemination of these pathogens under field conditions.

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