

## Indexing of Bamboo Mosaic Virus and Extension of Virus-free Clones/Plants<sup>1</sup>

Yeh, C. C., A. H. Cheng<sup>2</sup> and H. Y. Hwang<sup>3</sup>

### Abstract

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This study was undertaken to survey the occurrence of bamboo mosaic virus in the major growing areas of ma bamboo (*Dendroclamus latiflorus* Munro.) and green bamboo (*Bambusa oldhami* Munro.), to set up a green bamboo nursery to produce virus-free clones/plants for the farmers, and to evaluate the effect of virus on the yield and quality of green bamboo shoots. Eye-inspection and/or ELISA methods were periodically used for the survey of the disease. In general, incidence on green bamboo was more severe than that on ma bamboo. The percent of infection on native green bamboo based on visual symptoms varied in locations : with almost 100% in Wuku, 98.4% in Kuanmiao, 91.7% in Chiali, 81% in Chushan, 67.4% in Minghsiung and Talin, 24.9% in Paiho and Tungshan, and no infection observed in Tashi. Native ma bamboo was found with 66.3% infection in Minghsiung and Talin, 65.2% in Kukeng and Tounan and 47.3% in Phaiho and Tungshan. Wuko green bamboo was found with 6.4% infection in Chiali, 2.2% in Minghsiung and Talin, and no infection observed in Paiho and Kuanmiao. A nursery with 96 virus-free mother clones/plants was started at Hsinhua Branch Station in 1990. The following two years, this nursery produced 820 virus-free clones for the farmers. Yield of the bamboo shoot from diseased plants in 1991 and 1992 were 48.7% and 18.7%, respectively, less than that from healthy plants and the quality from healthy plants was much better.

Key Words : bamboo mosaic virus, virus-free clones/plants.

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1. Contribution No. 208 from Tainan District Agricultural Improvement Station.

2. Deputy Director, and Assistant Plant pathologist, respectively, Tainan DAIS, 350, Section 1, Linsen Road, Tainan 701. Taiwan R. O. C.

3. Associate Agronomist and Head of Hsinhua Branch Station, Tainan DAIS.

## Introduction

Bamboo is a forest plant or crop of great value in Taiwan. Bamboo shoot is an important vegetable especially during the summer. Because it is rich in fiber and vitamins and low in calories, it has been considered a natural health food. As a vegetable, ma bamboo (*Dendroclamus latiflorus* Munro.) and green bamboo (*Bambusa oldhami* Munro.) are of economic importance among the others that are grown in Taiwan. Bamboo shoot of ma bamboo was a major canned product for export while green bamboo shoot is used mainly as a fresh vegetable, and a small portion is used for processing.

Bamboo shoots have traditionally been produced in different kinds of soils by Chinese without any difficulty. However, during the 1970's, virus diseases became economically important (4,5). Differences in resistance were observed in different species/varieties (5). Unfortunately, ma bamboo and green bamboo are very susceptible to virus infection. Previous studies revealed that the disease is caused by a potexvirus-bamboo mosaic virus, and is mechanically transmitted (1,2,3,4). No vector has been reported yet, The virus is transmitted mainly by cutting knives and/or during cultural practices via farming tools. Most of the farmers know that the disease may greatly affect the quality of bamboo shoots. Some farmers also believe that the yield is reduced at least 30% . However, no accurate information from quantitative and/or qualitative studies is available. Although many other diseases and pests have been reported on bamboos, mosaic virus is the most destructive disease affecting the farmers. Effective ways such as roguing of the diseased plants or treatment of the cutting knives with sodium hypochloride are not commonly used by the farmers due to the lack of convenience. This study was undertaken to:(i) survey the occurrence of bamboo mosaic virus in the major growing areas of ma bamboo and green bamboo in Taiwan, (ii) initiate a green bamboo nursery to produce virus-free clones/plants for the farmers to control this disease, and (iii) evaluate the effect of this virus on the yield and quality of green bamboo shoots.

## Material and Methods

### Survey of the disease

Occurrences of the disease between 1989 and 1991 in the major growing areas of ma bamboo and green bamboo were surveyed based on the visual mosaic symptoms on leaves. The observations were surveyed confirmed by the ELISA method in the lab. Percentage of the plants infected were recorded.

### **Establishment of virus-free nursery**

Virus-free plants of green bamboo were transplanted to an isolated virgin field plot at Hinhua Branch Station in 1990. This nursery was consistently indexed once a month by ELISA, and the infected plants, if any, were rogued.

### **Extension and demonstration of virus-free clones/plants**

Newly developed clones/plants from the mother plants in the nursery were sent to the farmers on request and used in a newly planted field plot at Kuanmiao for demonstration and for the evaluation of virus effect on the yield and quality of bamboo shoot. A field day was also held for the farmers to demonstrate to them the effect of virus on the quality and yield of bamboo shoot which may accelerate the acceptance and use of virus-free clones/plants.

### **Evaluation of virus effect on the yield and quality of bamboo shoot**

Yield (Kg.) and quality as determined by bottom diameter, shoot length, shoot weight, cutforce, and soluble material of the bamboo shoots from the demonstration plot were collected and compared with that from the diseased plot planted at the same time.

## **Results**

### **Occurrence of the disease**

Severity of the disease varied in locations and/or varieties/cultivars (Table 1). Native green bamboo is more seriously infected than ma bamboo or wuko green bamboo. In the northern part of Taiwan, native green bamboo was found with 100% infection in Wuku while no infection was observed in Tashi. The other major growing areas of native green bamboo such as Kuanmiao, Chushan, Minghsiung and Talin were also recorded with a very high percentage of infection (Table 1). Virus infection of ma bamboo is also high but it is not as severe as in native green bamboo (Table 1). Most of wuko green bamboo is grown in southern Taiwan, and it is less severely infected (Table 1).

### **Virus-free nursery of native green bamboo**

In 1990, a virus-free nursery was established at the Hsinhua Branch Station of Tainan District Agricultural Improvement Station with 96 clones/plants of native green bamboo after visual-inspection and indexing by ELISA. The mother clones/plants were obtained from Paiho, Kuanmiao and Hsinhua Branch Station. This nursery has been indexed periodically once a month since then, and the new clones/plants were distributed to the bamboo farmers at their request.

Table 1. Occurrence of bamboo mosaic virus in the major growing areas in Taiwan.

Location	Infected grove (%)		
	Green bamboo (Native)	Ma bamboo (Native)	Green bamboo (Wuko)
Wuko	100.0	—* <sup>*</sup>	—
Tashi	0.0	—	—
Chushan	81.0	—	—
Kukeng, Tounan	—	65.2	—
Minghsiung, Talin	67.4	66.3	2.2
Chiali	91.7	—	6.4
Paiho, Tungshan	24.9	47.3	0.0
Kuanmiao	98.4	—	0.0

\* No data is available.

#### Extension and demonstration of virus-free clones/plants

In April, 1990, sixty-six virus-free clones/plants were planted on a new plot at Kuanmiao for demonstration. The plot was also indexed once a month, and four infected plants were rouged in September, one in November 1990, and the other in April 1991. The remaining plants have not been infected so far and they are under periodical inspection by ELISA. Until the fall of 1992, there were 820 virus-free clones/plants produced and distributed to the bamboo farmers in Taiwan from the nursery. Among them, 100 clones were planted in Taichung, 150 in Minghsiung, 550 in Kuanmiao and 20 in Pingtung.

On July 15, 1992, a field day was held at the demonstration plot for the farmers, scientists, and administrators from government. The participants especially the farmers, were impressed with the deteriorative effect of virus on the yield and quality of bamboo shoot.

#### Evaluation of virus effect on the yield and quality

As shown in Table 2, the yield of bamboo shoots from virus-free demonstration plants was much higher than that from the diseased plants. The yield from 60 groves of healthy or diseased plants was 1,865 Kg and 957 Kg, respectively, or 48.7% of yield reduction in 1991, and 2,427 Kg and 1,972 Kg, respectively, or 18.7% of yield reduction in 1992. Bamboo shoots produced from the diseased plants were smaller and more slender, and were found with less soluble material and more fibers than bamboo shoots from healthy plants. Therefore, the quality of bamboo shoot was greatly reduced by virus infection. (Table 3).

Table 2. Comparison of the yield of bamboo shoot from virus-free and diseased plants

Harvesting peroid	Virus-free Plants	Diseased plants	Ruduction
April — Oct. 1991	1,865 Kg	957 Kg	48.7%
Mar. — Sep. 1992	2,427 Kg	1,972 Kg	18.7%

Yields of the bamboo shoot were the accumulated fresh weight from 60 groves of plants.

Table 3. Comparison of the quality of bamboo shoots from virus-free and diseased plants

Quality of bamboo shoot	Virus-free plants	Diseased plants
Bottom diameter (cm)	6.63	6.42
Shoot length (cm)	19.09	20.28
Shoot weight (g)	215.38	205.64
Cutforce (g/cm)	442.00	495.46
Soluble material (Brix)	5.51	5.40

Date were the mean values from the four harvests on 26 Aug., 1 Sept., 9 Sept., and 10 Sept. 1991.

## Discussion

Results of the study indicated that there are still healthy plants available in the growing areas. If a control strategy is not undertaken in the less affected area, the disease may become as severe as in Wuko where it occurs with 100% incidence. Many farmers are still hesitating to renew their infected plants because it will require 1-2 years of lost production. The other problem is the nursery at Hsinhua cannot provide enough virus-free clones for all farmers in Taiwan. Profit or income from selling bamboo shoots is much higher than that from selling virus-free clones. This is also hampered the distribution of virus-free clones from the farmers fields, which were originally provided with material from the nursery, to the other farmers. Therefore, Tainan DAIS under the financial support by Council of Agriculture and Provincial Department of Agriculture and Forestry will assist the Kuanmiao Farmer Association to establish a nursery for selling virus-free clones. In 1992~1993, we also suggest farmers obtain clean clones from those areas that are not affected such as

Tashi.

The successful model in this study can also be used in preventing the spread of mosaic virus on ma bamboo and other susceptible varieties. This study also provided, for the first time, information concerning effect of virus on the quality and quantity of green bamboo shoot.

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# 竹類嵌紋病發生調查與無病毒 綠竹苗示範推廣<sup>1</sup>

葉忠川 鄭安秀<sup>2</sup> 黃和炎<sup>3</sup>

## 摘 要

本試驗之目的在調查本省麻竹及綠竹主要栽培地區被嵌紋病毒病危害的情形，並在新化分場設立綠竹無病毒母樹園，以提供無病毒苗供筍農栽培，以及評估嵌紋病毒對綠竹筍品質及產量之影響。從 1989 到 1992 年間，在農委會經費補助下，利用目測葉片上之嵌紋病徵及 ELISA 的方法在全省主要栽培區調查發病情形。普通綠竹，五股地區幾近 100% 被感染，竹山地區為 81%，關廟地區為 98.4%，佳里地區為 91.7%，民雄、大林地區為 67.4%，白河、東山地區為 24.9%，但在大溪地區二次之調查均未發現有病株。麻竹，在古坑、斗南地區為 65.2%，民雄、大林地區為 66.3%，白河、東山地區為 47.3%。烏殼綠竹發病較輕，僅在民雄地區及佳里地區分別發現有 2.2 及 6.4% 植株受感染，白河及關廟地區種植較少，也未發現病株。1990 年從各地調查獲得之無病毒株經 ELISA 確定後，在新化分場之處女地新種植一母樹園共計 96 株，每月利用 ELISA 方法測定一次，到目前並未發現有被感染現象，1991 及 1992 年從本母樹園共提供 820 株健康苗給農民，其中台中有 100 株，民雄 150 株，關廟 550 株及屏東 20 株。另外從母樹園所獲得之健康苗也於 1990 年 4 月在關廟歐茂進農友之新植田種植 66 株，做為示範觀摩與評估病毒對竹筍產量與品質之影響，附近同時新植之竹園則採用一般有嵌紋病之竹苗，其土壤及管理皆相似做為對照園，示範園中有 6 叢後來發現被感染，立即剷除，目前尚有 60 叢，並且每月調查一次。在影響產量及品質之評估方面，60 叢所採收鮮筍之重量，在 1991 年健株及病株分別為 1,865 公斤及 957 公斤，1992 年分別為 2,427 公斤及 1,972 公斤，亦即兩年病株產量分別減產 48.7% 及 18.7%。竹筍品質包括竹筍底徑、筍長、筍重、截切力及固形物，健株所採的筍均優於病株者。

**關鍵詞：**竹類嵌紋病毒、無病毒苗。

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1. 台南區農業改良場研究報告第 208 號。
  2. 本場副場長、助理研究員。台南市 701 林森路一段 350 號。
  3. 本場副研究員兼新化分場主任。