FORMOSANA

● A New Cavendish Variety developed by Somaclonal Variation.
● The most productive Cavendish not seen elsewhere.
● Resistant to Fusarium wilt race 4.

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Formosana: A New Cavendish Variety With Super High Yield and Fusarium Wilt Resistance Selected By Somaclonal Variation

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INTRODUCTION
For decades, banana production in Taiwan has been greatly challenged by the intractable Fusarium wilt problem, caused by *Fusarium oxysporum* f. sp. *cubense* race 4. For the control, the susceptible variety Giant Cavendish must be replaced by the resistant variety. For obtaining a resistant Cavendish whose breeding has been seriously handicapped by the female seed sterility, an appropriate method for breeding must be developed. Because in vitro propagation of banana has shown the potential for producing substantial genetic variability, known as ‘somaclonal variation’, an innovative breeding approach based on somaclonal variation was, therefore, taken by the Taiwan Banana Research Institute in 1984. Much interest, support, and effort have been devoted to this breeding program over the past 16 years leading to the continued discovery of many useful resistant clones. Among them, the new variety *Formosana* is the best, in terms of Fusarium wilt resistance and horticultural performance. To my best knowledge, this is the most productive Cavendish not seen elsewhere and is considered a breakthrough in banana breeding. Commercialization of *Formosana*, scheduled in 2002, would have great impact on Taiwan banana industry.

HORTICULTURAL CHARACTERS
*Formosana* is a somaclone derived from the wilt-susceptible variety Giant Cavendish, the major cultivar grown in Taiwan. It is about 2.8 m tall, similar to Giant Cavendish, but is different from the parent variety in the following horticultural characters:
1. Pseudostem is larger and stronger, and petioles slightly shorter; leaves are thicker, wider, upright, and bunched at the crown.
2. The bunch is cylindrical and compact, about 8.9 kg heavier, or 42% increase, consisting of 3 hands more than that of Giant Cavendish.
3. The hands are more uniform in size and fingers slightly less curved, giving better hand formation. They ripen normally and evenly with the sweetness, flavor, and shelf life essentially the same as those of Giant Cavendish.
4. The growing cycle is around 13 months, about one month longer than that of Giant Cavendish.
Comparison of salient features between *Formosana* and Giant Cavendish on the first plant crop

<table>
<thead>
<tr>
<th>Variety</th>
<th>Plant height (cm)</th>
<th>Pseudostem girth (cm)</th>
<th>Leaf ratio</th>
<th>No. of hand/bunch</th>
<th>No. of finger/bunch</th>
<th>Bunch weight (kg)</th>
<th>Crop cycle (month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GC</td>
<td>274</td>
<td>73</td>
<td>2.50</td>
<td>8.5</td>
<td>147</td>
<td>21.3</td>
<td>12</td>
</tr>
<tr>
<td>FM</td>
<td>281</td>
<td>28</td>
<td>2.33</td>
<td>11.5</td>
<td>191</td>
<td>30.2</td>
<td>13</td>
</tr>
</tbody>
</table>

GC: Giant Cavendish; FM: *Formosana*

**DEGREE OF RESISTANCE TO FUSARIUM WILT**

*Formosana* has a higher level of resistance to Fusarium race 4 than Tai-Chiao No. 1, the wilt-tolerant variety released for commercial production in 1992. Results of semi-commercial field trials showed that disease incidence on *Formosana* was 4.3% in 2000 and 4.1% in 2001; the corresponding figures were 9.4 and 9.8% for Tai-Chiao No. 1, and 25.5 and 29.6% for the wilt-susceptible Giant Cavendish.

Incidence of Fusarium wilt on *Formosana* compared to the major cultivars grown in Taiwan

<table>
<thead>
<tr>
<th>Variety</th>
<th>No. of farms surveyed</th>
<th>Range of disease (%)</th>
<th>Averaged disease (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Year 2000)</td>
<td></td>
</tr>
<tr>
<td>Giant Cavendish</td>
<td>5</td>
<td>14.1~63.7</td>
<td>25.5 c</td>
</tr>
<tr>
<td>Tai-Chiao No. 1</td>
<td>5</td>
<td>3.5~23.8</td>
<td>9.4 b</td>
</tr>
<tr>
<td>Formosana</td>
<td>10</td>
<td>2.4~11.8</td>
<td>4.3 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Year 2001)</td>
<td></td>
</tr>
<tr>
<td>Giant Cavendish</td>
<td>10</td>
<td>10.4~86.8</td>
<td>29.6 c</td>
</tr>
<tr>
<td>Tai-Chiao No. 1</td>
<td>15</td>
<td>4.7~38.3</td>
<td>9.8 b</td>
</tr>
<tr>
<td>Formosana</td>
<td>25</td>
<td>1.6~12.2</td>
<td>4.1 a</td>
</tr>
</tbody>
</table>

Means followed by the different letter differ significantly at p=0.05 according to Duncan's multiple range test.
REACTION TO OTHER MAJOR DISEASES AND PESTS

Based on field observation, Formosana and Giant Cavendish were similar in susceptibility to major diseases and pests such as the freckle disease, black Sigatoka, Acrodontium leaf speckle, bunchy-top virus, cucumber mosaic virus, and corn borer. The only exception is that Formosana appears to be more vulnerable to the corky scab thrip which causes a grey-brown to reddish roughening symptom on fruit skin.

GUIDELINES FOR CULTIVATION OF FORMOSANA

For commercial planting, the field management such as planting density, fertilization, and disease and pest control program recommended for use in cultivating the Giant Cavendish are also applicable to the new variety. Cultivating the new variety demands attention to the following particulars:
1. Because the crop cycle is slightly longer, Formosana must be planted about one month earlier than usual, to assure that most bananas can be harvested in the spring season, the most demanding period in both domestic and Japanese market.
2. With respect to the disease and pest control, special attention should be given to the control of corky scab thrips at shooting stage.
3. Formosana is not recommended for planting on those farms with poor drainage or insufficient water supply, or having too sandy and too acidic soil. Under these unfavorable conditions, the growth of banana is relatively poor, and the level of Fusarium wilt resistance would be reduced. It is important that field practices like over use of nitrogen and inadequate application of herbicides such as diuron and glyphosate, known to prevent the full expression of Fusarium resistance, should be avoided.

MAJOR IMPACT ON TAIWAN BANANA INDUSTRY

For controlling Fusarium wilt, two resistant varieties, Tai-Chiao No. I and Tai-Chiao No. 3, developed by this breeding program have been released for commercial planting. They are now planted on about 1,600 ha of infested farms in southern part of Taiwan. Although these two resistant varieties have enabled growers to resume banana production on many abandoned infested farms, moderate success has been obtained because both varieties are only mediocre in disease resistance and in productivity. Because of the advantages of high
level of Fusarium resistance and high yield, *Formosana* is scheduled for release for commercial planting, beginning January 2002, for replacing both Tai-Chiao No. I and Tai’Chiao No. 3. Commercialization of *Formosana* would have great impact on Taiwan banana industry as follows:

1. It would reduce the loss of production to Fusarium wilt from the present 15% level to less than 5% every year.

2. The yield per hectare would be increased by over 50%, thus greatly reducing the production cost, one of the key constraints for banana production in Taiwan.

3. For decades, Taiwan banana has been suffering from a seasonal uneven ripening problem that greatly reduces its competitiveness in the Japanese market.

   Planting *Formosana* to replace Giant Cavendish will solve this problem for bananas produced by *Formosana* ripen evenly.

4. By having a variety replacement program aiming at 1,000 ha in 2002, it is expected that the amount of exported banana would be increased from the present 2 million boxes per annum up to over 5 millions in 2003. More importantly, it is believed that more planting of *Formosana* in future has the great potential for Taiwan bananas to enter the new export markets because of the lower production cost and better fruit quality, thus more competitive, of this new variety.
A comparison of the appearance of a shot plant (upper), mature bunch (middle), and hands (bottom) between Formosana (FM) and Giant Cavendish (GC). Note that the larger cylindrical bunch produced by Formosana is more compact consisting of 3 hands more than that of Giant Cavendish, and fingers are less curved,
Formosana (FM) plants grew vigorously on two Fusarium-infested farms, while the Giant Cavendish (GC) and Tai-Chiao No. 1 (TC-1) planted on the same farm were infected seriously.

Bananas of Formosana collected from two packing houses ripened uniformly.