

Breeding Guava Resistant Lines Against *Myxosporium* Wilt

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Myxosporium wilt is one of the most severe diseases of guava (*Guajava psidium*) in Taiwan^(4, 5). The disease was first reported as Tachigare Byo (Likubin in Chinese) by Kurosawa in 1926⁽³⁾. It then caused an epidemic in 1970's and thereafter with total destruction of the orchards in many cases. The pathogen infects host tissues through wounds; induces systemic infection; causes defoliation and finally die^(4, 5). No chemical could cure the disease. However, a resistant source is available. The disease could then be alleviated by planting resistant clones. In this article, we attempt to make crosses and artificially inoculated the plants in order to obtain resistant clones. A preliminary report was presented earlier⁽⁶⁾.

In total twelve guava varieties and lines were used to make 32 combinations as shown in table 1. Three local commercial varieties: Chungshangpa, Laiapa and Peipa, and five introduced varieties: Ching-Mai, South Africa, Thai, Vietnam and 73917, plus four lines, R1, R2, R3, and R4 were used. Among them R1, R2, R3 and R4 were selected from a previous study. They were obtained from open pollinated crosses⁽⁵⁾ and derived from survives of consecutive inoculations in the disease nursery for two to three years.

Table 1. Distribution of resistant guava seedlings against *Myxosprium psidii* after six years artificial inoculation

Crosses or selfing (⊗)	Number of seedlings	Accumulated diseased plants during 1985-1990						Survived plants (%)
		1985	1986	1987	1988	1989	1990	
Ching-Mai ⊗	19	8	17	18				1(5.26)
Chungshangpa × R1	82	49	77	81				1(1.22)
Chungshangpa × R2	82	49	77	81				1(1.22)
Chungshangpa×Vietnam	112	61	102	110	111	112		0
Laiapa ⊗	50	20	46	50				0
Laiapa × R1	504	276	486	498	500	502		2(0.4)
Laiapa × R2	148	69	142	146	146	147		1(0.68)
Laiapa × R3	814	409	744	773	781	792		22(2.70)
Laiapa × R4	582	221	520	554	561	568	571	11(1.89)
Peipa ⊗	50	23	44	48	49	49		1(2.0)
Peipa × R2	276	101	224	249	253	261	263	13(4.71)
Peipa × R3	192	32	156	181				11(5.73)
Peipa × R4	533	160	453	476	481	498	500	33(6.19)
R1 ⊗	35	16	30	32	35			0
R1 × Laiapa	716	392	706	713	716			0
R1 × Peipa	231	82	160	183	187	200	204	27(11.69)
R2 ⊗	231	106	227	228	229	230	231	0
R3 ⊗	89	43	82	85	86	87		2(2.25)
R3 × Laiapa	149	51	144	149				0
R4 × Laiapa	868	450	814	837	845	853		15(1.73)
R4 × Peipa	521	115	389	449	457	473		48(9.21)
R4 × Thai	686	437	673	684	685	686		0
South Africa ⊗	354	134	337	345	349	352		2(0.56)
Thai × Peipa	100	36	88	95	98	99	100	0
Thai × R1	515	266	497	511	511	514		1(0.19)
Thai × R2	167	101	167					0
Thai × R3	435	217	417	434	434	435		0
Thai × R4	8	8						0
Vietnam × Laiapa	274	187	268	273				1(0.36)
Vietnam × R4	43	10	43					0
Vietnam × Thai	204	140	202	204				0
73917 ⊗	96	13	93	96				0
Total	9434	4411	4282	374	66	96	13	192(2)
% of diseased plants		46.8	45.4	4.0	0.7	1.0	0.1	

Crosses or selfing were conducted *artificially* between March 24 to April 20 in 1984 at the Fengshan Horticultural Experiment Station. The fruits obtained were harvested and their seeds were washed out on September 21 of the same year to produce seedlings as soon as possible.

M. psidii was isolated from the diseased trees in the Fengshan area and was made sporulation on potato dextrose agar as reported ⁽²⁾. Artificial inoculations with conidial suspensions (10^6 /ml) of *Myxosporium psidii* was conducted on *one-year* old trees grown in the field. Inoculations were performed two to three times annually and continually for six consecutive years.

Just before inoculation, shoot buds were removed to provide wound sites for infection. Inoculation was performed in the evening and inoculated trees and/or sites were covered by vinyl bags which were then removed the next *morning*.

Dead trees resulted from the artificial inoculations were recorded and rogue out before the next inoculation. However, the data *were* compiled as yearly basis.

As results, totally 14,645 seeds *obtained* and 9,434 seedlings were produced.

One year after the inoculation, 4,411 seedlings died due to the disease which comprised 46.8 percent for the total of 9,434 seedlings *grown*. In the second year 4,282 seedlings comprising 45.4 percent died. For the 3rd, 4th, 5th and 6th year, the percentage of the tested seedlings that died was 4, 0.7, 1 and 0.1 respectively. For six years, a total of 98 percent of the tested seedlings became diseased and died while 192 seedlings, 2 percent, remained healthy (Table 1).

Crosses that fail to survive in this trial are as follows: R3 × Laiapa, Thai × R2, Thai × R4, Vietnam × R4, Vietnam × Thai, Chungshangpa × Vietnam, Laiapa × R1, R4 × Thai, Thai × Peipa, Thai × R3 and 4 selfings i.e., Laiapa ⊗, 73917 ⊗, R1 ⊗, and R2 ⊗.

For 18 other crosses some seedlings survived after six years of continuous inoculation. Among them, Peipa is probably the best source of resistance as shown by the range of 1-48 plants surviving in five crosses and selfings. The highest survival rate was 11.69 percent was achieved with the cross Peipa × R1, in which 27 out of 204 seedlings remained healthy. The only cross without surviving plants was Thai × "Peipa".

Crosses were then compiled according to whether the varieties were used as maternally, paternally or selfed (Table 2). It was evident again that "Peipa" produced the most resistant plants with nearly 7 percent of the offspring healthy. It was followed by the selfing of "Ching Mai" with 5.3 percent survival of seedlings. However, the number of plants obtained was too few, only 19 seedlings, to be justified.

Fifty-seven clones had been selected for their quality from 192 surviving plants. They were derived from eight crosses and one selfing (Table 3). Four clones were further selected among those 57 clones. Among the four clones, three were the offsprings from the cross, R4 × Peipa, and one was from R1 × Peipa. Further investigations on these four clones are under study.

Table 2. Guava seedlings obtained from crosses divided by maternal, paternal and selfs on the susceptibility to *Myxosporium psidii*

Variety	Percentage of survival plants			Mean = (%)
	Maternal	Paternal	Selfs	
R1	2.8511 (1/2)	0.2922 (3/3)		31/2316=1.3385
R2	-	2.2229 (3/4)		15/673=2.0229
R3	0 (0/1)	2.2207 (2/3)		32/1590=2.0126
R4	3.0361 (2/3)	3.7736 (2/4)		107/3241=3.3015
Laiapa	1.7578 (4/4)	0.7972 (2/4)		52/4105=1.2668
Thai	0.0816 (1/5)	0 (0/2)		1/2115=0.0473
Peipa	5.5944 (3/3)	8.8028 (2/3)		133/1903=6.9890
Vietnam	0.1919 (1/3)	0 (0/1)		1/633=0.1580
Chungshangpa	0.3676 (2/3)			2/544=0.3676
South Africa			0.5650	2/354=0.5650
Laiapa			0	0/50=0
Peipa			2.0	1/50=2.0
R1			0	0/35=0
R2			0	0/231=0
R3			2.2472	2/89=2.2472
Ching Mai			5.2632	1/19=5.2632
73917			0	0/96=0

¹⁾ Parenthesis indicates number of crosses with survival plants out of the total number of crosses.

Mean: (Survived plants)/(Number of inoculated plants)

Table 3. Plants selected from the progeny survived after the artificial inoculation

Cross or Control	Number of Plants selected	Range of weight(g) per fruit	Range of brix
Laiapa × R3	5	99.2-183.8	6.9-8.7
Laiapa × R4	2	120-217.4	6.5-6.6
Peipa × R2	5	132.1-182.9	6.8-8.7
Peipa × R4	12	91.3-190.5	6.4-8.1
R1 × Peipa	8	145.4-175.9	7.1-9.1
R4 × Laiapa	2	154.6-190.5	6.6-9.5
R4 × Peipa	17	81.6-153.5	6.4-8.8
Vietnam ⊗	2	81.6-121.2	9.3
Vietnam × Laiapa	4	129.2-176.7	7.6-7.8
Chungshangpa (Control)		93.5	7.2
Laiapa (Control)		86.7	4.8
Peipa (Control)		79.9	7.1
Peipa (Selected No.1)	(Control)	115.4	7.0

Myxosporium wilt is a very destructive disease to guava. Abandonment of the orchards due to the disease is common when no proper care is taken. The disease was first reported in Taiwan⁽³⁾. However, the occurrence of a guava wilt, presumably caused by *Paecilomyces*, was reported from Malelane, South Africa in 1981⁽¹⁾. Although the disease and pathogen name given differed in the two countries, the description of symptoms, with wound infection and systemic distribution, causing of wilt and death of the infected plants could not be distinguished and the second author considers that even though different names were used in the two places it may be the same disease.

In the previous study⁽⁴⁾, Peipa was found to be resistant to *Myxosporium* wilt. As results shown, seedlings obtained from crosses of four lines R1, R2, R3 and R4, previously selected after artificial inoculation studies, showed 1.3 to 3.3 percent survival of plants. In contrast, crosses in the local susceptible variety Laiapa resulted in 1.3 percent survival of plants. Varieties "Thai", "Vietnam" and "Chungshangpa" were considered poor choice to raise resistant varieties (Table 2).

Mode of inheritance was still not clear as it seems a higher percentage of seedlings might be resistant to the disease than is evidenced by crosses using "Laiapa", a susceptible variety. However, it was clear that the way screening for resistance described in this article is probably quite artificially drastic. This point of view might be served by noting that only 2 percent of offspring from selfing of resistant Peipa survived.

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摘 要

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抗病品種白拔仔, 人工接種後選擇之抗病單株(R1, R2, R3 及 R4)及其它 7 品種, 做雜交或自交所得 32 組合培育 9,434 株。經每年接種病菌孢子懸浮液 2~3 次, 共 6 年得 192 抗病株, 在不同組合中發現白拔仔為親本時得抗病單株最多可達 7%。再以園藝特性為準, 初步選出之 57 株中有 4 株最有希望成為推廣品種。由本文得知番石榴立枯病之防治應可由抗病單株中選拔優良後代而獲得解決。

(關鍵詞: 番石榴、抗病育種、*Myxosporium* disease)