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Host Responses of Peanut Witches' Broom Disease[1]

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Abstract : The results confirmed that the peanut witches' broom disease (PnWB) could be transmitted to peanut, tomato, potato, alyce clover, purple bean, globe amaranth, periwinkle, *Ipomoea obscura* and *Ipomoea triloba* by insect vector *Orosius orientalis*, but no infection was found in sweet potato, loofah, cucumber, strawberry, water spinach, balsam pear, paulownia, creeping wood-sorral, chinese morning-glory, *Ipomoea pescaprae*, *Chenopodium amaranticolor* and *C. quinoa*. The PnWB affected plants developed typical witches' broom symptoms, and the symptoms of PnWB on tomato plants resembled those of tomato big bud or witches' broom disease. The sieve elements of PnWB infected plants were stained blue with Dienes' stain in sections of phloem tissues by light microscopic observation, but no blue taining reaction was found in the healthy ones. The fact indicated the presence of mycoplasma-like organism in the infected plants.

Introduction

Witches' broom diseases of legume occurred widely in the tropical areas of the world was recognized as mycoplasmadal etiology, and could be transmitted by leafhoppers or dodders, and had a wide range of host plants (1, 2, 4, 5, 6, 7, 8, 9, 10). Peanut witches' broom (PnWB) was found widely in Taiwan, and occurred severely about 50% of infection on Penghu island and could be transmitted by *Orosius orientalis* Matumura (5, 10). This study was attempted to test the responses of several plants to PnWB. In addition, the Dienes' stain method was also used to clarify the presence of mycoplasma-like organisms (MLOs) in PnWB-affected plants (3, 10).

Materials and methods

The insect vectors (*O. orientalis*) collected from peanut field were reared on healthy peanut plants in cages. Twenty one species (Table 1) of healthy plant seedlings were cultivated in pots in greenhouse. Nymphs of *O. orientalis* were fed on PnWB-affected peanut plants for 7 days aquisition feeding in cages, then transferred to healthy peanut

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plants for 16 days. The inoculation feeding was made about 9 to 12 days on test plants with those viruliferous insects. The symptom developments on test plants were observed about 6 months after inoculation feeding in greenhouse (5). The free-hand sections of those test plants stained with Dienes' stain were observed by light microscope (3, 10).

Results and discussion

The results of host responses to PnWB confirmed that peanut (*Arachis hypogaea*), tomato(*Lycopersicum esculentum*), potato (*Solanum tuberosum*), alyce clover (*Alysicarpus nummularifolius*), purple bean (*Phaseolus atropurpurea*), globe amaranth (*Gomphrena globosa*), periwinkle (*Vinca rosea*), *Ipomoea obscura* and *Ipomoea* triloba were susceptible to PnWB (Table 1. and Fig. 1), but no infection was found in sweet potato (*Ipomoea batatas*), loofah (*Luffa cylindrica*), cucumber (*Cucumis sativus*), strawberry

Table 1. Responses of various plants to peanut witches' broom transmitted by *Orosius orientalis* and staining reactions with Dienes' stain.

Test plants	No. of plants tested	No. of plants infected	Incubation periods in affected plants (days)	Blue staining reaction in phloem*
Lycopersicum esculentum Mill.	12	9	29—52	+
Solanun tuberosum L.	19	2	43—59	+
Alysicarpus nummularifolius DC.	16	12	48—80	+
Phaseolus atropurpurea DC.	8	6	41—68	+
Gomphrena globosa L.	7	5	28—59	+
Vinca rosea L.	37	21	11—47	+++
Ipomoea obscura Ker.	16	5	31—49	+
Ipomoea triloba L.	11	3	41—56	+
Arachis hypogaea L.	56	34	39—85	+
Ipomoba batatas Lam.	9	0**	—	—
Luffa cylindrica Roam.	12	0	—	—
Cucumis sativus L.	6	0	—	—
Fragaria chiloensis Ehrh.	11	0	—	—
Ipomoea aquatica Forsk.	9	0	—	—
Paulownia taiwaniana Hu *et* Chang	8	0	—	—
Momordica charantis L.	12	0	—	—
Oxalis cormiculata L.	31	0	—	—
Ipomoea sinensis Choisy.	19	0	—	—
Ipomoea pes-caprae Sweet.	21	0	—	—
Chenopodium amaranticolor Cost. and Rey.	11	0	—	—
Chenopodium quinoa Willd.	12	0	—	—

*Indicate the amount of cells stained blue in the phloem cells.
**No symptom was observed.

(*Fragaria chiloensis*), water spinach (*Ipomoea aquatica*), paulownia (*Paulownia taiwaniana*), balsam pear (*Momordica charantis*), creeping wood-sorral (*Oxalis cormiculata*), chinese morning-glory (*Ipomoea sinensis*), *Ipomoea pes-caprae*, *Chenopodium amaranticolor* and *Chenopodium quinoa* (Table 1). The PnWB affected tomato plants produced abnormal purple top, auxiliary bud, big bud, curly leaves and green flowers in early infected stage, then developed severe witches' broom symptoms (Fig. 1a). These symptoms resembled to those of big bud or witches' broom on tomato hitherto recorded by some authors (2, 6, 11), however, the relationship between tomato big bud or witches' broom and PnWB was unknown. The symptoms of PnWB-affected periwinkle plants showed same symptoms either transmitted by *O. orientalis* or by *Cuscuta chinensis* (Fig. 1e) (10). All sections from PnWB-affected plants showed specific blue staining reaction in phloem cells with Dienes' stain. These results indicated that the presence of phloem-limited MLOs in the PnWB-affected plants (Table 1). MLOs were abundant in diseased periwinkle tissues than in other hosts, however, the reasons of large amount of MLOs in periwinkle were unknown so far (6). Field investigations of PnWB made in Penghu district revealed that the PnWB occurred severely all over the fields, and the affected peanut plants beared seldom pods (Fig. 1g, 1h). Several plants including alyce clover, purple bean and kidney bean naturally infected with PnWB were suggested to be the important inoculum sources of PnWB in fields.

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Explanation of plates :

Fig. 1. Various plants infected with peanut witches' broom transmitted by *Orosius orientalis*.

(a) Diseased tomato (A) and the healthy plant (B).

(b) Diseased alyce clover (A) and the healthy plant (B).

(c) Diseased purple bean (A) and the healthy plant (B).

(d) Diseased globe amaranth (A) induced phylloid flowers (P), twisted small leaves (L) and the healthy plant (B).

(e) Diseased periwinkle (A) induced phylloid flowers (P), and the healthy plant (B).

(f) Diseased *Ipomoea obscura* (A), diseased *Ipomoea trilola* (B) and the healthy *Ipomoea obscura* (C).

(g) Diseased peanut (A) and the healthy plant (B).

(h) Diseased peanut (A) and the healthy plant (B) in field at Ponghu island.


A
B
1a
A
B
P
1e
B
A
1b
A
B
C
1f
A
B
1c
A
B
1g
P
L
A
B
1d
B
A
1h

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落花生簇葉病之寄主植物反應[1]

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摘 要

落花生簇葉病可經南斑葉蟬 (*Orosius orientalis* Matsumura)媒介傳染而感染落花生、蕃茄、馬鈴薯、山土豆、賽葵豆、千日紅、長春草、細花野牽牛及紅花牽牛。惟不能感染甘藷、絲瓜、胡瓜、草莓、甕菜、苦瓜、泡桐、酢醬草、白花牽牛、馬麻藤、紅藜及白藜。感染本病之病株顯現綠化花及異常分蘖之典型叢生病徵。在蕃茄罹病株之病徵與過去報告之蕃茄"big bud"或"witches' broom"相近似。本病病株篩管組織經 Dienes' stain 染色觀察，可呈現專一性藍色反應，健株植物則無此反應，此項結果證實各罹病株之擬菌質病原之存在。

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