HOST RANGE OF *Xanthomonas manihotis* Starr

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ABSTRACT

***Xanthomonas manihotis* Starr infected four species of euphorbiaceous plants, namely: *Manihot glaziovii* Muell.- Arg., *Manihot esculenta* Crantz (variegated ornamental cassava), *Euphorbia pulcherrima* Willd., and *Pedilanthus tithymaloides* (L.) Poit. The diagnostic character of the disease on the alternate hosts was similar to that on cassava which served as the control.**

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INTRODUCTION

Cassava bacterial blight, caused by *Xanthomonas manihotis* Starr, is now recognized as one of the most important diseases of cassava in the Philippines. Cassava production on affected areas is low and turn worse during the wet season when the disease can cause complete yield loss. The bacterial pathogen involved in the transmission of the disease can be easily disseminated by rain splashes, insects, water and through various activities of man in the field (Lozano and Sequeira, 1974).

In the absence of cassava, the pathogen may survive in native vegetation that serve as alternate hosts which may become the reservoir of inoculum for the next planting of the crop (Baker and Snyder, 1965; King, 1966; Doll, 1977). According to Baker and Cook (1974), the ability of the pathogen to invade, colonize and parasitize more than one alternate host may improve opportunities for infection of a primary host by providing the necessary food base.

This study identified the different weed species and other plants associated with cassava which may serve as alternate hosts of *X. manihotis,* the different symptoms of the disease on the alternate hosts and compared the symptoms of bacterial blight on cassava and other host plants.

MATERIALS AND METHODS

Twenty-six species of plants belonging to different families were used as test hosts. Fifteen potted plants were inoculated with *X. manihotis* for each species. Three methods of inoculation were followed: pin-pricking method, cutting method and injection method. In every inoculation test, Golden Yellow, a susceptible cassava variety was inoculated as check.

RESULTS AND DISCUSSION

Of the 26 species of plants tested, 4 responded to the inoculation test (Table 1). In general, symptom patterns resembled those caused by the pathogen in cassava plants. Susceptibility was found to vary among the different plant species tested.

On the highly susceptible plant species, the noticeable symptoms were observed as early as 4 to 6 days after inoculation. The less susceptible species showed symptoms 6 to 10 days after inoculation. Incubation period varied among infected plant species depending on the method of inoculation used (Table 1). The variation in inoculation period and symptom expression could be attributed to the distribution of the pathogen in the plant system.

Of the 4 alternate hosts, only *Pedilanthus tithymaloides* did not show any symptom of the disease when cut and prick methods of inoculation were used. However, when the inoculum was injected into the stem, it showed symptoms after 7 days. This could possibly be due to the accumulation of the pathogen in the apical stem of the plant and not in the leaves.

Degree of Susceptibility of Infected Host.

Of all the plants tested, only those belonging to family Euphorbiaceae showed positive pathological responses to inoculation (Table 2). However, the degree of

Table 1. Pathogenicity and incubation period (days) of *Xanthomonas manihotis* different host species.

Host Plant	Infection (%)	Incubation Period (days)[1]
Manihot esculenta [2]	100	4.4
Manihot glaziovii	100	4.4
Manihot esculenta [3]	100	5.2
Euphorbia pulcherrima	82	6.7
Pedilanthus tithymaloides	35	6.7

[1] Average of 3 trials replicated 6 times.
[2] Control plants (Golden Yellow variety)
[3] Variegated ornamental cassava.

Table 2. Degree of susceptibility of different plant species to inoculation with *Xanthomonas manihotis*.

Family/Common Name	Scientific Name	Degree of Susceptibility
Euphorbiaceae		
Rubber tree	*Manihot glaziovii* Muell.- Arg.	***
Variegated ornamental cassava tree	*Manihot esculenta* Crantz	***
Poinsettia	*Euphorbia pulcherrima* Willd.	**
Zigzag plant	*Pedilanthus tithymaloides* (Linn.) Poit.	*
Gatas-gatas	*Euphorbia hirta* Linn.	—
Convulvolaceae		
Sweet potato	*Ipomoea batatas* Lam.	—
Kangkong	*Ipomoea aquatica* Forsk	—
Moti-moti	*Ipomoea triloba* Linn.	—
Colocaceae		
Taro	*Colocasia esculenta* (L.) Schott.	—
Cyperaceae		
Nut sedge	*Cyperus iria* Linn.	—
Mutha	*Cyperus rotundus* Linn.	—
Pandan-pandan	*Cyperus difformis* Linn.	—
Graminaceae		
Barnyard grass	*Echinocloa crusgali* (Linn.) Beauv.	—
Padpad	*Echinocloa colunum* (Linn.) Link	—
Carabao grass	*Paspalum conjugatum* Berg.	—
Aquingay	*Rottboellia exaltata* Linn.	—
Cogon	*Imperata cylindrica* (Linn.) Beauv.	—
Other Species		
Paciencia	*Cleome rutidosperma* D.C.	—
Makahiya	*Mimosa pudica* Linn.	—
Golasiman	*Portulaca oleracea* Linn.	—
Baho-baho	*Ageratum conyzoides* Linn.	—
Botonsilyong gapang	*Gomphrena celosiades* Mart.	—
Botenesan	*Hytis capitata* Jacq.	—
Fantakuen	*Synedrella rodiflora* Gaerth.	—
Amaranthus	*Amaranthus spinosus* Linn.	—
Olasiman	*Peperomia pullucida* (Linn.) HBK	—

*** Highly susceptible — Water-soaked, irregularly angular spots distributed on the leaves; severe exudation; blighting occurs 5 to 8 days after inoculation.

** Moderately susceptible — Fine water-soaked spots, moderate coalition occurs 6 to 9 days after inoculation; no blighting.

* Less susceptible — Fine water-soaked spots leading to soft rot, followed by callus formation.

— No infection.

susceptibility varied according to the species involved.

1. *Manihot glaziovii* Muell. — Arg. (Rubber tree) and *Manihot esculenta* Crantz (variegated ornamental cassava). The disease appeared as water-soaked angular areas, clearly distinguishable on the surface of the leaves. These lesions became brown to dark-brown followed by the appearance of a yellow halo surrounding the spots. Several spots enlarged and coalesced forming a large necrotic area. Necrotic areas sometimes exuded bacterial exudates on the lower surface of the leaf and along the veins. Under severe infection, the vines became discolored and epidermis of infected young stems and petioles often developed cracks through which drops of bacterial exudate oozed out and dried (Fig. 1). Infected young stem tissues rotted, particularly in areas surrounding primary infection sites, resulting in a characteristic die-back symptom (Fig. 2).

On *M. glaziovii* and *M. esculenta*, the lesions were first evident on the underside of the leaves. It is possible that the pathogen multiplied within the substomata cavity and from it invaded and destroyed the spongy mesophyll tissues.

2. *Euphorbia pulcherrima* Willd (Poinsettia). The initial symptom of the disease was similar to that observed in *M. esculenta* but the

Fig. 1. Gum exudation on the stem (A) and blight symptoms (B) of *Manihot glaziovii* 5 days after inoculation with CBB pathogen.

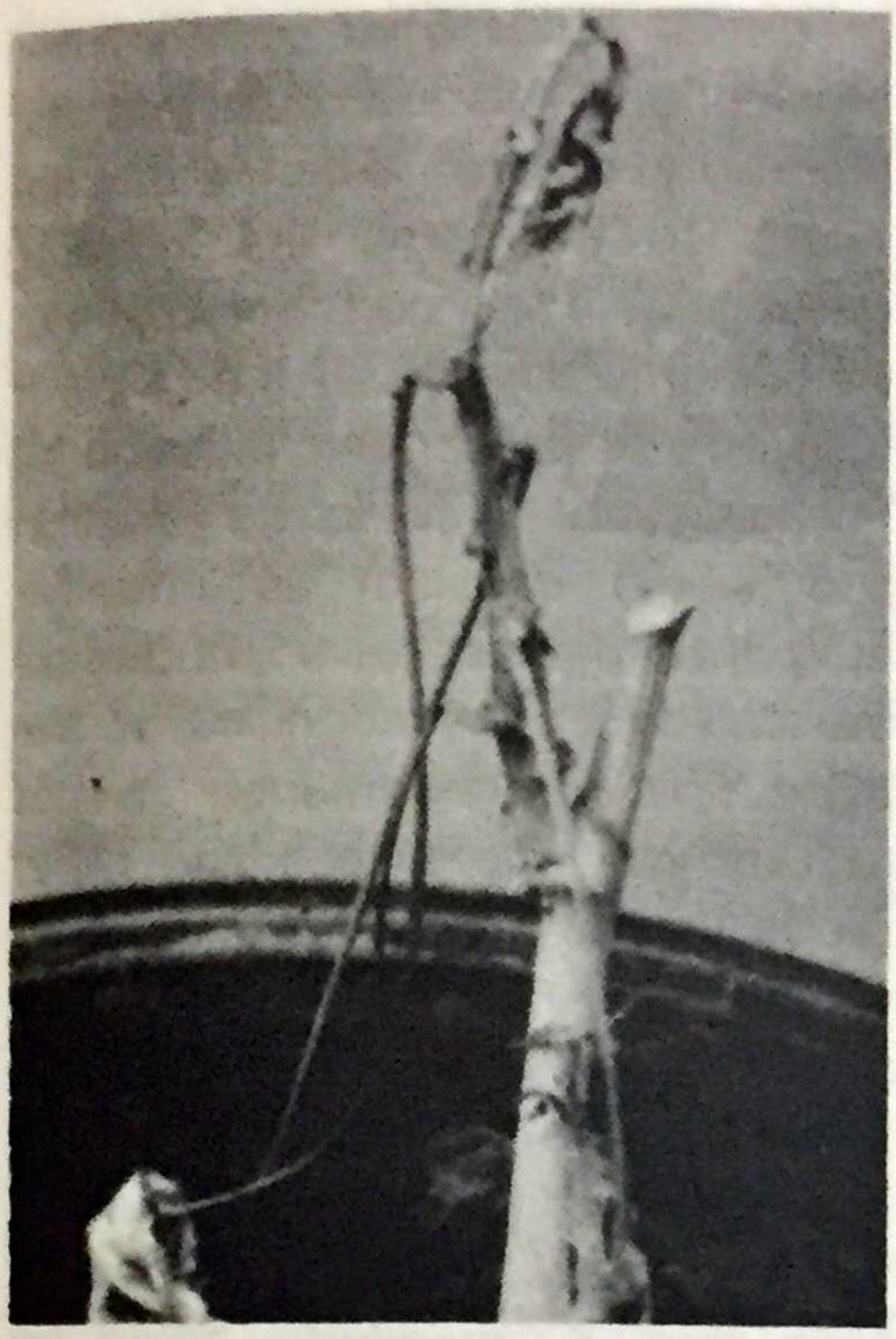

Fig. 2. Die-back exhibited by the variegated ornamental cassava 8 days after inoculation with *Xanthomonas manihotis*.

disease developed much slower compared to that of the more susceptible plants like variegated ornamental cassava (Fig. 3). The slow development of the disease could be attributed to the presence of some toxic substances or enzymatic inhibitors against the pathogen (Walker, 1975). Furthermore, the latex concentration in the sap of *E. pulcherrima* may be higher than that of the highly susceptible plant species so that the latex inhibited the entrance and invasion of the pathogen into the plant tissues. Also, compared to the latex of susceptible species, that of the *E. pulcherrima* would dry up or coagulate faster and, to some degree, prevent the pathogen from entering into the tissues.

3. *Pedilanthus tithymaloides* (Linn.) Poit. (Zigzag plant). At the

Fig. 3. Water-soaked lesions exhibited by poinsettia 15 days after inoculation by pricking; inoculated with sterile distilled water (left) and inoculated with a suspension of *Xanthomonas manihotis* (right).

initial stage of the disease, the infected leaves exhibited depressed, fine, water-soaked lesions, followed by necrosis and drying of infection site leading to callus formation (Fig. 4). The infected stems were discolored. They turned brown to purplish, and blackened as rotting progressed resulting in the death of the apical shoots of the plants. However, the disease was only concentrated at the site of inoculation and did not develop further towards the basal part of the plant. The rotting effect might be due to the activities of the pathogen in the tissues of the plant or the production of enzymes that dissolved the tissues.

Test plants that showed negative responses to inoculation (Table 2) produced callus 6 to 9 days after inoculation. This indicates that the plants have some defense mechanisms to overcome the invading pathogen. This corroborates the theory of Muller (1974) that a plant responds to pathogenic invasion by releasing substances in the infection site which can act as effective inhibitors against invaders unless the invaders are recognized by the plant. This phenomenon would explain why the weeds and other crops tested did not exhibit symptoms of the disease. It is also possible that the nutrient requirement for the pathogen could be specific only to plants belonging to Euphorbiaceae. However, it is possible that *X. manihotis* could be present in these plants but at a

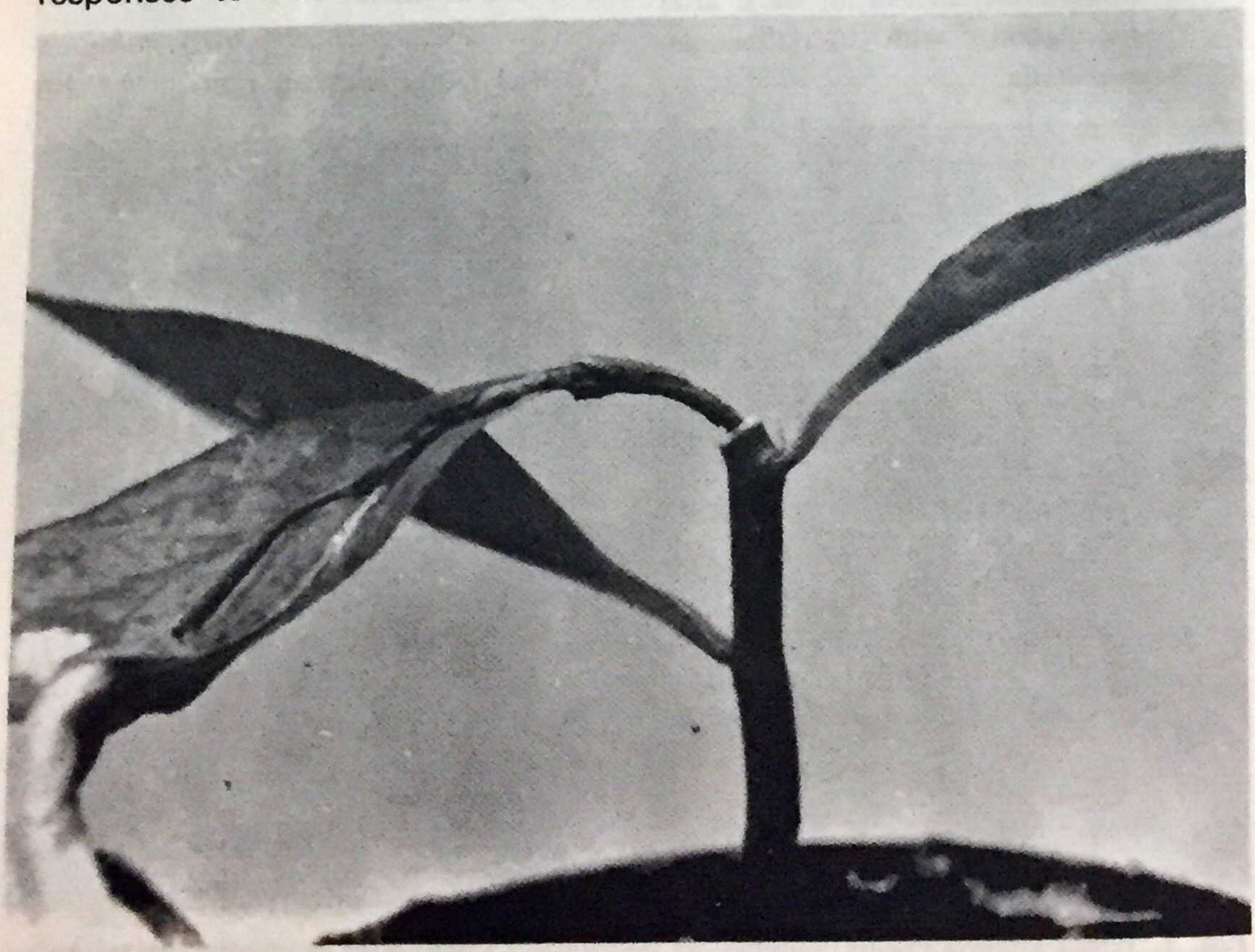

Fig. 4. Symptoms of CBB in *Pedilanthus tithymaloides* after inoculation by injection of *Xanthomonas manihotis*.

dormant stage, until a certain agent of dispersal would bring the pathogen to a susceptible host for infection.

Some plants, especially weeds, are capable of chemical exclusion. At the point of penetration, it is possible that enzymes present are the polyphenol oxidases which release phenols into the substrate inhibiting progress of the pathogen (Walker, 1975). Weeds are also capable of producing toxic substances which inhibit activities of foreign matters that enter the plant. An example is *Rottboellia exaltata,* an obnoxious weed, which is capable of tolerating and resisting the attack of any pathogen due to its enzymes and physiological make-up (cell and tissue structure) which are adapted to the situation (Klingsman and Ashton, 1975).

Back Inoculation Test.

Cassava showed bacterial blight symptoms when inoculated with bacteria isolated from *E. pulcherrima* and *P. tithymaloides.* Susceptible cassava variety (Golden yellow) when inoculated with *X. manihotis* from the different host plants exhibited similar severity and incubation period of the disease. This shows that the same pathogen caused the disease in these species of plants. Control measures against bacterial leaf blight should therefore take into consideration these alternate hosts.

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