COLLAR AND ROOT ROT OF AIBIKA (*ABELMOSCHUS MANIHOT*) I. PATHOGENICITY AND EFFECT OF SYSTEMIC FUNGICIDES

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ABSTRACT

Collar and root rot disease of aibika (Abelmoschus manihot *(Linnaeus) Medicus) is caused by the fungus* Phytophthora nicotianae *var.* nicotianae *B. de Hann. A pathogenicity study conducted in the glasshouse showed that the fungus infects the collar region of the stem and then progresses downwards to destroy the root system, killing the plant. Field and glasshouse trials using three systemic fungicides, Ridomil 5G (metalaxyl), Le-San DX 70 WP (fenaminosulf) and Plantvax 5G (oxycarboxin) were carried out to study their effect on the disease. Aibika plants were inoculated with the fungus. In the field trial fungicides were applied at 5 g product per plant after the plants became infected. Ridomil and Le-San DX gave significant control of the disease and increased yields. In the glasshouse trial the fungicides were applied at 2, 5 and 10 g product per plant. Ridomil and Le-San DX were effective at 5 g. At 10 g both fungicides were phytotoxic. These two fungicides had a curative effect on the disease. Time of application of fungicides appeared to be critical in obtaining control of the disease.*

INTRODUCTION

Aibika (*Abelmoschus manihot* (Linnaeus) Medicus) is the most important of the traditional leafy green vegetables grown in Papua New Guinea. It is particularly important in the lowlands, where it is grown in over 75% of food gardens (Koley 1981, 1982). The young leafy shoots are harvested and used as food. Aibika has a higher nutrient content than most other green leafy vegetables (Westwood and Kesavan 1982). It is a woody perennial, usually grown as an annual and it is propagated vegetatively by stem cuttings.

Aibika suffers from a disease affecting the collar region of the stem and the root system, leading to the death of the whole plant. In several sites at Laloki Horticultural Research Station near Port Moresby the disease appeared to be severe, killing many plants. Graham (1971) recorded this disease in Fiji caused by *Phytophthora nicotianae* var. *parasitica* (Dastur) Waterhouse and listed other hosts of this fungus. Detailed studies were started at Laloki in September 1981 to investigate the causal factors of the disease and its control. In this report the role of the causal organism and the effect of systemic fungicides are described.

Symptoms of the Disease

The major symptoms of the disease are yellowing of the mature lower leaves, wilting of younger foliage and the growing tip, followed by defoliation. Rotting of the stem begins at the collar region and progresses downwards to the root system. Uprooting

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the diseased plant in an advanced stage shows the whole root system rotted. Affected plants eventually die.

Identification of the Pathogen

A species of *Phytophthora* de Bary was isolated on V8 juice agar from the infected roots and collar region of stems of aibika. It was identified as *P. nicotianae* B. de Haan. An isolate of this fungus sent to the Commonwealth Mycological Institude, England, was confirmed as *P. nicotianae* var. *nicotianae* (A2 mating type), O.J. Stamps (pers. comm.), (CMI No. IMI 262913).

MATERIALS AND METHODS

Three trials were conducted:

1. Pathogenicity test in the glasshouse

Cuttings of aibika, cv. Laloki 2, with eight vegetative buds per stem were planted in 15 cm diameter pots filled with sterile soil. Thirty days after planting when the new vegetative growth was about 20 cm in length, the plants were inoculated with *P. nicotianae* var. *nicotianae*. For inoculation the fungus was grown in pure culture on 2% V8 juice agar in 12 cm Petri plates. The inoculum was prepared from seven day old cultures by mixing with sterile water in a Waring blender at the rate of 100 ml of water per Petri plate culture to obtain a heavy inoculum. One hundred ml of the inoculum were poured around the base of the stem after the soil was removed to a depth of about 3 cm. The soil was replaced. Twenty five plants were inoculated. A further 25 plants were treated with sterile water to serve as the uninoculated control.

2. Field fungicide trial

The field trial was conducted at Laloki Horticultural Research Station, Port Moresby. The systemic fungicides tested were Ridomil 5G (metalaxyl, Ciba-Geigy), Le-San DX 70 WP (fenaminosulf, Bayer) and Plantvax 5G (oxycarboxin, Uniroyal Chemical). Ridomil and Le-San DX are recommended fungicides for the control of *Phytophthora* diseases of many crops. Plantvax has been reported to be effective as a soil fungicide against *P. palmivora* (Butler) Butler the cocoa pod rot fungus (Okaisabor 1970) and *Pythium aphanidermatum* (Edson) Fitzpatrick the causal organism of stem rot of tomato (Matta 1972).

These fungicides each applied at 5 g product per plant, were compared with an untreated control in a randomized block design with seven replications. The plots were four ridges (spaced 1.3 m apart) wide and 8 m long. There were 32 plants per plot, but all assessments were made on the twelve plants in the centre two ridges. The plants were inoculated with *P. nicotianae* var. *nicotianae* 35 days after planting when the new vegetative growth was about 25 cm in length. The inoculation procedure was the same as that described for the pathogenicity trial in the glasshouse. The fungicides were applied 10 days after inoculation when the symptoms of the disease (yellowing of lower leaves, wilting and discolouration of the stem at the collar region) were obvious on many plants. Although the disease symptoms started appearing 3 to 4 days after inoculation, the fungicides could not be applied between the 4th and 9th days because the soil was too wet after heavy rain. Soil was removed around the stem to a depth of about 3 cm, the fungicide was sprinkled around the base of the stem and the soil was put back to cover the fungicide. The control plants were inoculated but received no fungicide treatment. A pre-treatment count of infected plants was made before application of the fungicides. Three subsequent counts were made at 10 day intervals. These counts were analysed

by covariate analysis with adjustment for the pre-treatment count. Three harvests were made of all the leafy shoots 11, 13 and 15 weeks after transplanting to determine total shoot weight.

3. Glasshouse fungicide trial

A trial using the same three fungicides was laid out in the glasshouse. There were three rates of application, 2, 5 and 10 g of product per plant. Plants were raised and inoculated as described under the pathogenicity test. Plants were arranged in a set of five plants in a row to form a block with 10 plants in two rows for each treatment. Fungicides were applied, using the same method as in the field trial, four days after inoculation when the disease symptoms were observed.

RESULTS

1. Pathogenicity test

Plants inoculated with the fungus showed yellowing of lower leaves in three to five days. The collar region of the stem appeared water soaked and discoloured. This was followed by wilting of growing tips in about six to eight days, followed by defoliation. These plants died three weeks later. On uprooting these plants, it was observed that the infection apparently started from the collar region, progressed downwards and killed the root system. Uninoculated control plants were healthy with vigorous vegetative growth. *P. nicotianae* var. *nicotianae* was reisolated from the collar and roots of the infected plants.

2. Field fungicide trial

The percentage of diseased plants before and after the fungicide application is given in *Table 1*. Thirty days after application the proportion of diseased plants was significantly lower for Ridomil and Le-San DX treated plots compared to Plantvax and the untreated control. Ridomil and Le-San DX treated plants appeared to be more robust and vigorous in growth (*Table 1*).

3. Glasshouse fungicide trial

All plants died due to infection in the untreated control, and in all three

Table 1.—**Effect of systemic fungicides on collar and root rot of aibika (field trial)**

Fungicide	Percent infected plants (angular transformation) (1)		Total shoot weight t/ha
	Pre-treatment	Post-treatment(2)	
Le-San DX	30.4 (25.6)	50.9 (60.2)	2.55
Ridomil	31.4 (27.2)	48.6 (56.3)	2.25
Plantvax	38.6 (38.9)	67.7 (85.6)	0.76
Control (no fungicide)	27.2 (20.6)	74.9 (93.2)	0.50
Mean	31.9	60.5	1.52
s.e.d. (d.f 18)	7.11	5.49	0.515
C.V. (%)	28.3	9.1	33.9
Significant effect ($p<0.05$)	n.s.	11.58	1.082

Notes: (1) Back transformed values are shown in brackets.
(2) Post-treatment means are adjusted by co-variance analysis for pre-treatment means.
n.s. Not significant.

rates of Plantvax. The two higher application rates of Ridomil completely controlled the disease. At 5 grams of product per plant, Le-San DX gave 70% survival of plants. Infected plants showed signs of recovery two weeks after the fungicide application. Plants shed all the old leaves and new ones started growing. After four weeks the plants had healthy foliage. At the higher application rates, both Le-San DX and Ridomil caused phytotoxicity symptoms of leaf scorching and defoliation (*Table 2*).

DISCUSSION

Pathogenicity studies established that *P. nicotianae* var. *nicotianae* is the causal organism of collar and root rot disease of aibika. The site of infection appears to be the collar region of the stem. Further studies are needed to understand the mode of entry of this fungus at the site of infection. The fungus caused total loss of vegetative growth by killing the plants. The short incubation period of three to five days showed that this fungus was a virulent pathogen.

Two of the systemic fungicides tested in the field, Ridomil and Le-San DX gave significant control of the disease and increased yields. However, an additional 17% and 21% of plants died during the post-treatment period in the Ridomil and Le-San DX treated plots respectively. This may have been due to the delay in application of the fungicides. On the other hand in the glasshouse, Ridomil and Le-San DX afforded effective control at 5 g product per plant, applied four days after inoculation when the early symptoms of the disease were observed. These plants recovered. This implies that the time of fungicide application is critical. Le-San DX at 10 g was phytotoxic and as a result 60% of the treated plants died. The remaining plants, though they survived, showed toxic symptoms of necrotic spots and scorching.

Effective control of the disease appears to be possible with Ridomil and Le-San DX if applied as soon as the early symptoms are observed. Le-San DX has a LD 50 of 60 mg/kg which is very toxic for a fungicide; it is not recommended for use by small holding farmers. The granular formulation of Ridomil is easy for field application and the cost of chemical per plant is K0.04 at the selling price of K8.00 per kg of Ridomil 5G in 1983.

Table 2. **Effect of three systemic fungicides in controlling artifically induced infections of collar and root rot of aibika applied four days after inoculation (glasshouse trial)**

Fungicide (in grams product/plant)		Pre-treatment		Post-treatment(1)	
		Infected	Health	Infected	Healthy
Control (no fungicide)		4	6	10	0
Plantvax	2g	3	7	10	0
Plantvax	5g	5	5	10	0
Plantvax	10g	2	8	10	0
Ridomil	2g	5	5	4	6
Ridomil	5g	3	7	0	10
Ridomil	10g	6	4	0	10*
Le-San DX	2g	2	8	8	2
Le-San DX	5g	5	5	3	7
Le-San DX	10g	4	6	6**	4*

Notes: 1 Four weeks after treatment
* Phytotoxic symptoms on leaves
** Plants died due to phytotoxicity

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