LEAFSPOT OF TARO (*COLOCASIA ESCULENTA* (L.) SCHOTT) IN GHANA AND SUPPRESSION OF SYMPTOM DEVELOPMENT WITH THIOPHANATE METHYL

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ABSTRACT

A foliar disease of taro (*Colocasia esculenta (L.)* Schott) in Ghana, which manifests as diffuse, circular to irregular spots, mostly on older leaves ultimately resulting in leaf blight, was found to be caused by *Cladosporium colocasiae* (Saw.). Isolates of *C. colocasiae* used in pathogenicity tests were virulent on taro but generally non-pathogenic to cocoyam (*Xanthosoma sagittifolium* (L.) Schott). A study of disease progress on individual leaves of upland taro indicated that spots appear on newly unfurled leaves after 12 days and the leaf blight stage occurs 24 days later. Of sixty-four taro plantings surveyed in nineteen towns and villages, forty-six (71.9%) were growing in swamps, twelve (18.8%) under semi-upland conditions and six (9.3%) under strictly upland conditions. The disease was observed in fifty-eight (90.6%) of the plantings. It was either absent or unimportant on swamp-grown taro, moderate on semi-upland taro and most severe on the upland crop. In an upland field trial, each of the six different application rates and spray schedules tested with Topsin M (thiophanate methyl 70 WP), significantly reduced disease progress. Thus, leaf spotting disease could be effectively managed with the fungicide in the upland / semi-upland regions of Ghana.

Key Words: *Cladosporium colocasiae*, disease progress curve, pathogenicity, Topsin M

RÉSUMÉ

Au Ghana, une maladie foliaire de taro (*Colocasia esculenta* (L.) Schott) qui se manifeste sous forme de taches diffuses, circulaires à irrégulières sur les vieilles feuilles qui deviennent flétries, était identifiée comme étant causée par *Cladosporium colocasiae* (Saw). Les isolats de *C. colocasiae* utilisés en test de pathogénécité étaient virulent sur le taro mais généralement non pathogénique sur le cocoyam *Xanthosoma sagittifolium* (L.) Schott). Une étude sur la progression de la maladie sur les feuilles individuelles de taro de montagne a montré que les taches apparaissent sur les feuilles jeunes de 12 jours encore recroqueviées et l'étape critique de flétrissement de feuilles intervient 24 jours plus tard. Sur les 64 cultures de taro enquêtées dans 19 villes et villages, 46 (71.9%) étaient en marrais, 12 (18.8%) en conditions de semi-montagne et 6(9.3%) étaient strictement en conditions de montagne. La maladie était observée dans 58 (90.6%) cultures. Elle était absente ou peu importante sur le taro planté en marais, moderée sur le taro de semi-montagne et plus sévère sur le taro de montagne. Dans un essai en champ en conditions de montagne, chacune de différentes doses d'application et de fréquences de pulvérisation de Topsin M (Thiophanate methyl 70 wp) reduisait significativement la progression de la maladie. En cas de manifestation à grande échelle de la maladie sur le taro de montage et semi-montagne au Ghana, la maladie des taches de feuilles pourrait être effectivement controlée à l'aide du fongicide.

Mots Clés: *Cladosporium colocasiae*, Courbe de progression de la maladie, pathogénécité, Topsin M

INTRODUCTION

Taro (*Colocasia esculenta* (L.) Schott), a hitherto neglected crop in Ghana, generally found growing along streams and in swamps, is increasingly receiving attention for development as a primary subsistence, upland/semi-upland crop. Experimental evaluations of the crop at the University of Science and Technology (UST), Kumasi, Ghana under upland/semi-upland conditions are hindered by a foliar disease which seems to be more severe in conditions of soil moisture stress. Symptoms of the disease appear as tiny, brown spots mainly on the older leaves. These expand and either become circular (5 - 10 mm diameter) or irregular and diffuse. Many of the spots coalesce to cover a substantial portion of the leaf blade which subsequently becomes chlorotic. As the disease progresses, the petiole becomes flaccid from the apex towards the base and begins to lodge. The leaf blade may be partially or completely blighted at this stage. The petiole ultimately falls off and, with the leaf blade still attached, becomes completely blighted.

Some of the symptoms are similar to those described by Plucknett *et al.* (1970) for *Cladosporium* leafspot but no definite pathological investigations have been conducted on the disease. Théberge (1985) alluded to possible occurrence of the disease in Africa but admitted to absence of any report on the disease from the continent. Investigations on the leaf spotting disease of taro are necessary, more so when taro is being developed for upland/semi-upland cultivation in Ghana.

This paper reports studies on the etiology of the disease, its nature of spread on individual leaves, distribution in some parts of Ghana, and control with the systemic fungicide, Topsin M.

MATERIALS AND METHODS

An initial determination of the causal agent of the disease involved a study of symptom types on upland taro at the Arable Crops Farm of the Department of Crop Science, University of Science and Technology (U.S.T.), Kumasi. Plants growing in swamps along streams and backyard drainage channels in Kumasi were also observed for

symptoms. Diseased leaf samples were obtained from infected plants and squash mounts of necrotic segments observed with a compound microscope. In another approach, 12 mm^2 segments of necrotic lesions were incubated (7 days) in humified petri plates and observed as above. Associated fungi were identified using standard texts (Ellis, 1971; Barnett and Hunter, 1972). Isolation of *Cladosporium colocasiae* from diseased taro leaves was also carried out on a pigeon pea medium (Awuah, 1989), and sub-cultures maintained on cassava glucose agar (CGA).

Since the fungus sporulated sparingly on CGA, a mixture of mycelial fragments and conidia were used in pathogenicity tests involving three isolates. For each isolate, a 10-day-old, light-grown CGA culture was flooded with 30 ml tap water and the superficial mycelium scrapped off and homogenised (15 - 20 sec.) in a Waring blender. Two pot-grown plants, each of cocoyam (*Xanthosoma sagittifolium* (L.) Schott) and taro, were inoculated by atomising 10 ml of the conidial/mycelial suspension onto the leaves. Inoculated plants were enclosed in transparent polythene bags and maintained in a screenhouse. They were sprayed daily (for 7 days) with tap-water, after which the polythene bags were removed and plants rated for disease 5 days later. One uninoculated plant each of cocoyam and taro served as controls.

Leafspot progress was studied on individual taro leaves in an upland planting with a high disease incidence. Newly unfurled leaves from selected plants were tagged and monitored daily for symptom initiation and subsequently for the progression of one symptom type to another based on the following syndrome scale: 0 = No disease; 1 = Presence of tiny brown spots on the upper leaf surface; 2 = Spots 5 - 10 mm in diameter but no coalescence; 3 = Coalescence of spots, more than 70% of the leaf covered; 4 = Leaf either chlorotic or becoming so but no petiole lodging; 5 = Initiation of petiole lodging with or without leaf blight; and 6 = Collapse of petiole accompanied by complete leaf blight.

Distribution of the disease in Ghana was partly ascertained by surveying taro plantings under both swampy and upland/semi-upland conditions in and around the U.S.T. campus, plus eighteen

towns and villages in the Ashanti, Western and Eastern Regions of Ghana. In all, sixty-four plantings were surveyed.

Control of the disease with Topsin M 70 WP (thiophanate methyl) was investigated in an upland field experiment at the Arable Crops Section of the Department of Crop Science, U.S.T. Topsin M was selected because it was more effective than Dithane M-45 80 WP (mancozeb) and Kocide 101 but as effective as Benlate 50 WP (benomyl) (Awuah, R.T., unpublished data). It was also cheaper and more readily available than benomyl. The field used had been successively cropped thrice with taro and, as a result, had a high incidence of *Cladosporium* leafspot. An experimental area measuring 12.5 x 10 m² was cleared, worked up with a hoe and planted with taro suckers in rows at a spacing of 50 cm x 50 cm. Weeds were controlled whenever necessary by hoeing.

Thirty-five well established plants (5-7 leaf stage) were randomly selected, and the partially unfurled disease-free leaf of each plant was tagged. Five of these leaves received each fungicide treatment under test (Table 1), 7 days later. The remaining leaves were untreated and served as the control. Topsin M was applied by a 1.5 L capacity spray gun. Treated and untreated leaves were scored for disease as described earlier. Disease progress curves were drawn for each treatment and the areas under the curves (AUDPC; Shaner and Finney, 1977) calculated and statistically analysed.

RESULTS

Cladosporium colocasiae was consistently observed on necrotic segments from diseased taro leaves collected from the field. The fungus was also frequently isolated from such diseased tissues. However, on older leafspots and tissues from partially blighted leaves, *Choanephora cucurbitarium* (Beck and Rav.) Thaxt, often occurred together with *C. colocasiae*.

All six taro plants inoculated with the three isolates of *C. colocasiae* became severely diseased 12 days after inoculation. Only one cocoyam plant manifested very mild, atypical symptoms in a parallel inoculation test. Uninoculated control plants were disease-free.

On field-grown naturally infected plants, the disease appeared as tiny brown spots on leaves 12 days after unfurling. The spots attained the 5 - 10 mm diameter stage after 12 additional days. Five days later, most of the spots coalesced and covered about 70% of the leaf surface. Within 3 days, the leaf became chlorotic. Petiole lodging, with or without leaf blight commenced 2 days thereafter. The petiole finally collapsed to the ground and was blighted after 2 - 3 days. Thus, it took about 36 - 37 days for the expression of the entire disease syndrome to occur.

The disease occurred in almost every taro planting surveyed in the Ashanti, Eastern and Western Regions of Ghana. Forty six of the sixty four plantings surveyed (71.9%) were growing in swamps, twelve (18.8%) under semi-upland conditions, and six (9.3%) under upland culture. The disease was moderate to severe on all the semi-upland plantings and severe on all their upland counterparts. It was, however, insignificant on forty of the swamp-grown plantings (87%) and completely absent from six (13%). The disease was also not observed on cocoyam.

Disease progress was slower on leaves treated

TABLE 1. Application rates and frequency of Topsin M sprays against *Cladosporium* leafspot of taro

Fungicide treatment	AUDPC	% Disease reduction	Total No. of sprays
Untreated (Control)	27.2	0.0	0
490g a.i. ha⁻¹; 9 day spray schedule	18.0	33.8	3
490g a.i. ha⁻¹; 6 day spray schedule	16.2	41.2	5
980g a.i. ha⁻¹; 9 day spray schedule	9.6	64.7	3
490g a.i. ha⁻¹; 3 day spray schedule	8.4	69.4	10
980g a.i. ha⁻¹; 6 day spray schedule	7.4	72.3	5
980g a.i. ha⁻¹; 3 day spray schedule	6.4	76.5	10
LSD (0.01)	6.1		

with Topsin M than on the untreated controls, and the AUDPC's for all fungicide-treated leaves differed significantly (P ≤ 0.01) from that of the untreated leaves (Table 1). Among the treated leaves, the AUDPCs were not significantly different when Topsin M was applied either at 980 g a.i. ha⁻¹ (3, 6 and 9 day schedules) or at 490 g a.i. ha⁻¹ (3 day schedule). These four spray schedules all resulted in significantly less disease than spray schedules involving 490g a.i. ha⁻¹ (9 and 6 day schedule) (Table 1).

DISCUSSION

The present study, which has proven the leaf spotting disease of taro to be *Cladosporium* leafspot, is the first detailed study and published report on the disease in Ghana. Théberge (1985) noted lack of reports on the disease in Africa, even though he recognised its presence in most fields. This could be attributed to the crops generally low economic status in Africa, making it unattractive for detailed scientific investigations.

Cladosporium leafspot is reported to be unimportant in the Pacific region (Plucknett *et al.*, 1970). This is probably because, in that region, paddy culture of taro is practised (Plucknett *et al.*, 1970). Under such growing conditions, incidence and severity of leaf spotting, if any, are low as observed for swamp-grown taro in the present study. On upland and semi-upland taro in Ghana, however, the disease was important.

For some diseases, an interaction exists between plant/soil water status and host resistance. Generally, a soil/plant water status more favourable to the pathogen than to the plant enhances disease (Edmunds, 1964; Ghaffar and Erwin, 1969). This condition appears to occur in the taro - *Cladosporium* leafspot disease complex in upland soils.

Absence of the disease on young leaves (less than 12 days old) and its slow development on such leaves when attacked (17 days are required for spots to expand, coalesce and cover a substantial portion of leaf surface) suggest that *Cladosporium colocasiae* is a weak pathogen which attacks maturing leaf tissue. Increased susceptibility of plant tissue to disease with age has been widely reported (Wade, 1956; Sitterly *et al.*, 1957;

Meredith, 1966). Thus, factors such as improved host nutrition (Tisdale *et al.*, 1985) and soil moisture (Boyer, 1973; Tisdale *et al.*, 1985) which enhance the physiological development of a plant and would seem to delay maturation should be studied with respect to *Cladosporium* leafspot of taro.

Topsin M was effective at all concentrations and spray schedules tested against *Cladosporium* leafspot. This is remarkable considering the high rainfall and humidity that prevailed in between fungicide applications. Application of the fungicide at 490 g a.i ha⁻¹ (9 day-schedule) would be cheapest but this achieves only 33.8% reduction in disease progress. However, since of the present value of taro is low in Ghana, this rate and application schedule would seem appropriate especially in dryer weather. To reduce cost, fungicide application should start not earlier than 90 days after planting, since loss of leaves during this period does not affect yield (Aggarwal and Mehrotra, 1987).

Since older taro leaves are more susceptible to the disease, chemical control, if adopted should mainly focus on such leaves. Therefore, it is recommended that innermost leaves should be sparingly sprayed but outer leaves without symptoms or are about to attain disease stage two (i.e. spots 5 - 10 mm diameter) or approaching disease stage three (coalescence of spots), should receive more fungicide coverage to protect the remaining uninfected, but highly susceptible leaf tissue. It would be worthless to apply fungicides to older leaves after coalescence of spots and initiation of chlorosis because, subsequent to these stages, the disease develops rapidly resulting in petiole lodging and death of the entire leaf.

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