

Evaluation of certain fungicides for the control of tar spot disease of water yam (*Dioscorea alata* L.) in Ghana

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SUMMARY

Tar spot disease of water yam (*Dioscorea alata* L.) is widespread in all yam growing regions of Ghana. Although it does not usually cause more than 30 per cent loss in yield, it has the potential and has been observed to cause complete crop failure under favourable conditions. The present study evaluated the favourable conditions as well as the effectiveness of fungicides in controlling the disease. Benlate, Dithane M-45 and Polyram-Combi at the rates of 1.0, 1.5 and 1.5 g/l of water respectively either totally or almost completely controlled the disease when aerial parts of the vines were sprayed weekly or bi-weekly. Benlate was the most efficient, followed by Dithane M-45 and then Polyram-Combi. There were no significant differences in disease severity between plants sprayed weekly and bi-weekly. The use of Benlate, Dithane M-45 and Polyram-Combi increased yield by 63.0, 47.0 and 27.0 per cent respectively. It is suggested that a bi-weekly spraying programme should be followed to control tar spot disease of water yam.

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Introduction

Yams are not only one of the most important carbohydrate sources, but also an important source of highly utilizable proteins in the diets of West Africans (Coursey & Haynes, 1970; Waitt, 1963). The immediate control of economically important yam diseases, which include the tar spot disease, therefore, appears to be imperative.

The tar spot disease appears early and severely to cause complete crop failure in some districts of Ashanti and Brong-Ahafo regions where heavy

RÉSUMÉ

TWUMASI, J. K.: *Evaluation de l'efficacité de certaines fongicides pour la lutte contre la maladie "tar spot" de Dioscorea alata L. au Ghana.* La maladie "tar spot" d'igname (*Dioscorea alata*) est répandue dans toutes les régions du Ghana où l'on cultive cet igname. Bien que la perte du rendement due à cette maladie ne dépasse pas 30 % normalement, il y a la possibilité et, en effet, une perte totale de la récolte a été observée lorsque la maladie attaque dans des conditions propices. Cette étude a évalué ces conditions et l'efficacité des fongicides pour la lutte contre la maladie. Benlate, Dithane M-45 et Polyram-Combi aux taux de 1.0, 1.5 et 1.5 g par gallon de l'eau (4.5l) respectivement, ont presque contrôlé la maladie lorsqu'on a traité des plantes une ou deux fois par semaine. Benlate était le plus efficace des trois, suivi par Dithane M-45 et enfin Polyram-Combi. Il n'y avait pas de grandes différences entre la gravité de la maladie dans les plantes traitées une fois par semaine et celles traitées deux fois par semaine. Les utilisations de Benlate, Dithane M-45 et Polyram-Combi ont augmenté les rendements aux taux de 63, 47 et 27%, respectivement. Il est conseillé qu'une programme de traitement de deux fois par semaine soit suivi pour protéger l'igname contre la maladie "tar spot".

rainfall favours its development (Leather, 1959). Although Twumasi (1986) isolated six fungi, namely *Alternaria alternata* (Fr.) Keissler, *Cercospora carbonacea* Miles, *Cladosporium herbarum* (Persoon) Link ex S.F. Gray, *Colletotrichum capsici* Butler and Bisby, *Corynespora cassicola* (Berk and Curt.) Wei, and *Curvularia eragrostidis* (P. Henn.) J. A. Meyer, from diseased vines, he associated *C. eragrostidis* with the causal agent of the tar spot disease. He based this on Koch's postulates and

the effect of sterile fungal culture filtrates obtained from detached leaves and ex-plants. The pathogen has also been reported to cause a similar disease on *Dioscorea alata* L. in India (Borborua & Medhi, 1980). The disease was first described in Ghana by Leather (1959), but it has to date received little attention and no method for its control has been recommended.

The present study evaluated the effectiveness of certain fungicides in controlling the disease.

Materials and methods

Using the poisoned-food technique (McCallen, 1959), the effect of some selected fungicides on the growth of *C. eragrostidis*, isolated from naturally infected water yam leaves, was studied in the laboratory. The six fungicide treatments included Benlate (Methyl butyl carbomoyl - 2 - benzimidazole carbamate), Dithane M-45 (Maneb, zin-manganese salt of ethylene bidithiocarbamate), Polyram-Combi (Metiram, a complex of Zinc polyethylene thiuram disulphide), Calixim-M (Tridemorph, N-tridecyl-2, 6-dimethyl-Morpholine + maneb) and Duter (Triphenyltin hydroxide) as well as sterile distilled water as the control. Benlate, Dithane M-45 and Polyram-Combi treatments which either totally or nearly completely inhibited growth of the fungus at 1000 ppm were selected for further testing in the field.

Seed yams, prepared by cutting tubers of water yam into half pieces were used in field tests at Fumesua, near Kumasi (forest zone) and Ejura (forest-savanna transitional zone) in Ashanti region of Ghana. The Afase-Mane water yam variety tubers were obtained from observation plots established at Kwadaso, near Kumasi. The field layout included four mounds/treatment and spaced 1.2 m apart. There were five replications and the treatments were completely randomized. Weekly and bi-weekly spraying was started soon after disease onset, using the following dosage: Dithane M-45, Polyram-Combi and Benlate at the rate of 1.5, 1.5 and 1.0 g/l of water respectively. Spraying was done for 10 weeks using a knapsack sprayer model CP3, manufactured by Cooper,

Pegler and Company, Burgess Hill, Sussex, England.

At the end of the growing season, 32 weeks after planting, disease assessment and yield data were taken and subjected to statistical analyses. Disease assessment was done by rating disease severity for each plant on a 0-5 scale (0 = disease free, 5 = 100% disease severity). Disease severity was measured in terms of the mean disease index.

Results

It was observed from the laboratory studies that lower concentrations (1 and 10 ppm) of all the chemicals, except Benlate, had a stimulatory effect on the *in vitro* growth of *C. eragrostidis*. At 1 ppm, Calixin-M, Duter, Polyram-Combi and Dithane M-45 stimulated the growth of the fungus more than the control, while at 10 ppm Calixin-M, Duter and Polyram-Combi stimulated the growth of the fungus more than the control. At 100 ppm, no chemical was found to be stimulatory to fungal growth, and the decreasing order of efficacy was Benlate, Dithane M-45, Polyram-Combi, Calixin-M and Duter. Results obtained at 1000 ppm were similar to those at 100 ppm. Regardless of the concentrations used, Benlate effectively inhibited the growth of the fungus.

Chemical application results for Benlate, Polyram-Combi and Dithane M-45 on the mean disease indices of water yam sprayed weekly and bi-weekly at Fumesua are presented in Table 1 and those obtained at Ejura are presented in Table 2.

At Fumesua, there were significant differences between the various treatments. Water had the highest mean disease index of 5.0. Benlate had the least mean disease index of 1.6 and was therefore the most efficient of all the treatments in controlling tar spot disease of water yam. It was followed by Dithane M-45 and Polyram-Combi which performed alike and were significantly lower than water. Although weekly application had a higher index (about 6%) than bi-weekly, the difference was not significant.

At Ejura, the trend followed that at Fumesua

TABLE 1

Effect of Fungicidal Application on the Mean Disease Index of Water Yam at Fumesua

Treatment	Time of application		Treatment mean	
	Weekly	Bi-weekly	5%	1%
Benlate	1.6	1.6	1.6c*	b
Dithane M-45	4.0	3.6	3.8b	a
Polyram-Combi	4.2	3.8	4.0b	a
Water (control)	5.0	5.0	5.0a	a
Time mean	3.7	3.5		

LSD 0.05 = 0.93

LSD 0.01 = 1.3

CV % = 20 %

*Figures followed by the same letter are not significantly different.

TABLE 2

Effect of Fungicidal Application on the Mean Disease Index of Water Yam at Ejura

Treatment	Time of application		Treatment mean
	Week	Bi-weekly	
Benlate	2.0	2.0	2.0c*
Dithane M-45	3.8	4.0	3.9b
Polyram-Combi	3.8	4.4	4.1b
Water (control)	4.8	4.8	4.8a
Time mean	3.6	3.8ns	

LSD 0.05 = 0.42

LSD 0.01 = 0.59

CV % = 15 %

*Figures followed by the same letter are not significantly different.

at 5 per cent level of significance. Water had a mean disease index of 5.0, a significantly higher index than the other treatments. Dithane M-45 and Polyram-Combi performed alike and had higher indices than Benlate. As at Fumesua, the time of application did not affect the performance of the fungicides since no interaction was observed. Bi-weekly application gave an insignificantly higher (6%) mean disease index than weekly. The reverse occurred at Fumesua where there were no significant differences between disease intensities of plants sprayed weekly and bi-weekly. At the end of the study, almost all the

control plants were dead (Fig. 1), while Benlate-treated plants were still fresh and green (Fig. 2).

The percentage reduction in disease severity



Fig. 1. Water yam plant sprayed with water (control).

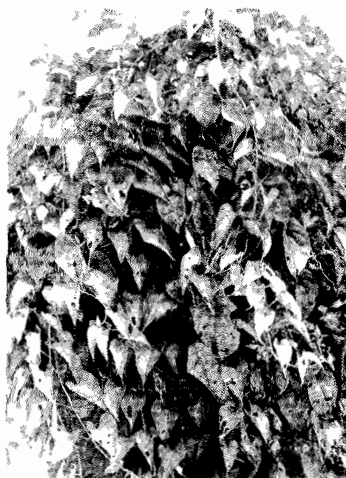


Fig. 2. Water yam plant sprayed with Benlate.

by chemical application ranged between 55.3 and 114.9 per cent at Fumesua and between 50.0 and 20.0 per cent at Ejura.

The effect of folia spraying on the yield of water yam at Fumesua and Ejura was similar to

the effect on mean disease indices. The results obtained at Fumesua are given in Table 3.

TABLE 3
Effect of Chemical Control of Water Yam Tar Spot Disease on Yield (kg) per Plot at Fumesua

Treatment	Time of application		Treatment mean
	Weekly	Bi weekly	
Benlate	9.0	10.2	9.6a**
Dithane M-45	6.7	8.2	7.5ab
Polyram-Combi	8.8	8.5	8.7a
Water (control)	6.3	5.4	5.9b
Time mean	7.7	8.1	

LSD 0.05 = 2.2*

CV % = 16.7 %

* Significant at 5 per cent level

** Figures followed by the same letter are not significantly different.

Application of Benlate gave the highest yield of 9.6 kg/plot, which was 63 per cent significantly higher than the application of water, the least yielding treatment. However, there were no significant differences in yield among Benlate, Polyram-Combi and Dithane M-45. Polyram-Combi out-yielded water significantly by 47 per cent. There were no significant differences in yield between Dithane M-45 and water, although the former gave a higher (27%) yield. Bi-weekly application of fungicides gave yields higher than weekly, but the differences were not significant.

Discussion

The stimulatory effect of low concentrations of Calixin-M, Dithane M-45, Duter and Polyram-Combi on the *in vitro* growth of *Curvularia eragrostidis* points to the possible danger in using low concentrations of these chemicals to control tar spot disease. Apparently, the Arndt-Schutz law (mere reference) which states that toxicants at low concentrations are stimulatory, also applies to these fungicides.

There were no significant differences between the mean disease indices of plants treated weekly and bi-weekly. This indicates, for economic reasons, that any spraying programme to control the

disease should be done every 2 weeks. Preliminary studies had shown that if spraying was done at intervals longer than 2 weeks, e.g., at monthly intervals, only Benlate could be used to control the disease, the rest not being very effective.

Although all fungicides tested controlled the disease, Benlate was the most efficient, based upon the mean disease indices obtained. It was followed by Dithane M-45 and then Polyram-Combi. The percentage reduction on disease severity was higher at Fumesua than at Ejura. This might be due to the differences in the macro-environment where rainfall was heavier at Fumesua, and, therefore, more favourable for disease development.

There were highly significant differences between yields of treated plants, and no significant differences between yields of plants treated weekly and bi-weekly. The effect of the test fungicides on yield followed a pattern similar to their effect on mean disease indices, Benlate being the most efficient.

Soaking seed yams in suspensions of the fungicides before planting was not considered in the present study. It is perhaps worthy of investigation.

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REFERENCES

- Borborua, A. & Medhi, G. (1980) *Dioscorea alata*, a new host of *Curvularia eragrostidis*. *Indian J. Mycol. Pl. Path.* 9 (92), 282.
- Coursey, D. G. & Haynes, P. H. (1970) Root crops and their potential as food in the tropics. *Wld Crops* 22, 261-265.
- Leather, R. I. (1959) Diseases of economic crops of

Ghana other than cacao. *Min. Fd agric. Bull.* No. 2, 96 pp.

Twumasi, J. K. (1986) Fungi associated with tar spot disease of water yam (*Dioscorea alata* L.) in Ghana. *Ghana Jnl agric. Sci.* **14-19**, 115-119.

Waite, A. W. (1963) Yams, *Dioscorea* species. *Fld Crop*

Abstr. **16**(3), 145-157.

McCallen, S. E. A. (1959) Evaluation of fungicides in the laboratory. In *Plant pathology: Problems and progress 1908 - 1958* (ed. C. S. Holton, G. W. Fisher, R. W. Fulton, H. Hart and S. E. A. McCallen). Madison, Wisconsin: University of Wisconsin Press.