J. Natn. Sci. Foundation Sri Lanka 2003 31(3&4): 427-429

SHORT COMMUNICATION

FUMIGANT ACTION OF SELECTED ESSENTIAL OILS AGAINST BANANA FRUIT PATHOGENS

KRISHANTHI ABEYWICKRAMA*, SULALI ANTHONY and RANSILU WATAWALA

Department of Botany, University of Kelaniya, Kelaniya

(Received: 06 January 2003;accepted: 10 July 2003)

Abstract: The antifungal nature of selected essential oils was screened against banana fruit pathogens using a fumigant bioassay. *Cymbopogon nardus* (L.), *Ocimum basilicum* (L.), *Eucalyptus citriodora* Hook *and Elettaria cardamomum* (Maton) oils were fungistatic on *Lasiodiplodia theobromae*, *Fusarium proliferatum* and *Colletotrichum musae* at concentrations between 0.03 - 0.66 % (v/v) and fungicidal at concentrations between 0.05 - 0.66 % (v/v). This simple and cost effective bioassay could be used as a preliminary screening method to identify the efficacy of plant oils, before *in vivo* testing is conducted.

Key words: Banana fruit diseases, bioassay, oil fumigants

INTRODUCTION

Banana is grown on a relatively large scale in many districts in Sri Lanka. Crown rot disease in banana fruit is caused by *Colletotrichum musae*, *Fusarium spp.*, *Verticillium theobromae*, *Lasiodiplodia theobromae* and anthracnose disease by *Colletotrichum musae.*[1] Commercial control of banana diseases is by post-harvest spray or dip treatment with fungicides such as benomyl and thiabendazole.[2] Consumer demand is for agricultural products that are organically grown and hazard free. The fruit sector in Sri Lanka urgently needs to develop environmentally friendly post-harvest treatments that are acceptable to consumers.

METHODS AND MATERIALS

Essential oils of *Cymbopogon nardus* (L.) Rendle (Ceylon citronella), *Eucalyptus citriodora* Hook and *Elettaria cardamomum* (Maton) (cardamom) are in abundant supply in Sri Lanka; these oils and *Ocimum basilicum* (L.) (Indian Sweet Basil) possess antimicrobial properties.[3,4] Attempts were made to screen the fungistatic and fungicidal efficacy of the above oils against banana fruit pathogens using a fumigant bioassay. This technique, if effective, could be extended to any volatile plant oil in order to identify fungistatic and fungicidal efficacy.

* Corresponding author

Virulent strains of *Colletotrichum musae*, *Fusarium proliferatum* (IMI # 385824) and *Lasiodiplodia theobromae* (IMI # 384870) previously isolated from crown rot and anthracnose diseased 'ambul' banana were used for this survey (Anthony *et al,* unpublished). Oil of *C. nardus* was a donation from the Department of Export Agriculture, while *O. basilicum*, *E. citriodora* and *E. cardamomum* oils were purchased from Aromatica Laboratories and Citro Essential Oils (Pvt.) Ltd., Colombo. Potato Dextrose Agar (3 mm in thickness) placed in 30 ml McCartney bottles were sterilized in an autoclave for 20 minutes at 1.03 $kg.cm^{-2}$ at 121 ^0C. Solidified PDA was inoculated with a seven day old fungal disc of each test pathogen (3 mm in diameter). Subsequently, a series of volumes (5 - 250 µl) of the test oils dissolved in ethanol (1:1 oil: ethanol) were dispensed on to 15mm thick adsorbent cellulose sponges of "Scotch Brite", which were inserted under the lid of each bottle. The caps of the bottles were closed and incubated for 7 days at room temperature (28 ± 2 ^0C).[5] The control (without oil) and ethanol (solvent) were also tested. The volumes of oils added were converted to percentages by considering the volume of the McCartney bottles (30 cm^3) and is expressed as % of oil added. **The Minimum Inhibitory Concentration** (MIC) - (fungistatic effect) of each oil was noted. Whenever the growth was completely inhibited, the fungal discs were transferred to fresh PDA plates to test the revival of each fungus and the **Minimum Lethal Concentration** (MLC) (fungicidal effect). The experimental design was a complete randomized design (CRD) with five replicates per treatment, and the results were analyzed by ANOVA.

RESULTS

All three Sri Lankan essential oils tested, exhibited significant fumigant activity ($p< 0.05$) against the test pathogens in comparison to the control and the ethanol treatment. The oil of *O. basilicum* was the most efficacious, demonstrating fumigant activity against all three test fungi at relatively low concentrations (MIC= 0.03±0.01- 0.06±0.01% and MLC = 0.05±0.02- 0.2±0.01 %). *Cymbopogon nardus* and *E. cardamomum* displayed moderate fumigant activity against test pathogens with MIC between 0.13±0.02 - 0.60±0.01 % and MLC between 0.25±0.01- 0.60±0.01%. *Eucalyptus citriodora* oil demonstrated both fungistatic and fungicidal activity at the same concentration range against all three test pathogens (0.33±0.01- 0.66±0.02%). *Colletotrichum musae* required the least concentration of the four oils for fungal inhibition. Fungicidal effects of the vapour sphase of *C. nardus* and *O. basilicum* have been demonstrated against *Penicillium digitatum* and *P. italicum*.[5] *Eucalyptus citriodora* oil has been effective in inhibiting *F. moniliforme* at a concentration of 5% (v/v).[6] *Elettaria cardamomum* oil has previously exhibited a growth inhibitory effect against *Monilinia fructicola*.[4] The major antifungal components present in these oils were identified as α -pinene, camphor, β-caryophyllene, citronellol and α-phellandrene (Anthony *et al*, unpublished) which are complex terpene hydrocarbons and oxygenated derivatives. However,

the relative fumigant action of essential oils may not easily be correlated with any individual component, but with a mixture of compounds present in these oils.

CONCLUSION

The present survey provides an understanding of the fungicidal efficacy of the oils that could be further tested on bananas in designing a novel treatment system to control post-harvest pathogens. This simple, cost effective and relatively rapid bioassay could be used as a preliminary screening test of plant oils against pathogens of interest.

Acknowledgement

The authors wish to acknowledge the financial assistance provided by the International Foundation for Science (IFS), Sweden, the Organization for the Prohibition of Chemical Weapons (OPCW), the Netherlands, and the University of Kelaniya.

References

1 Abeysekara C., Ratnayake S. & Adikaram N.K.B. (1997). Resistance of banana fruit to fungal disease. *Proceedings of the Australian Center for International Agricultural Research*, **80**: 93 -94. Canberra, Australia.

2 Al Zaemey A.B., Magan N. & Thompson A.K. (1994). *In vitro* studies of the effect of environmental conditions on the anthracnose pathogen of bananas, *Colletotrichum musae. International Biodeterioration and Biodegradation* **23**:369-381.

3 Dube S.P., Upadhay D. & Tripathy S.C. (1989). Antifungal, physico-chemical and insect repellant activity of the essential oil of *Ocimum basilicum. Canadian Journal of Botany* **67**: 2085 - 2087.

4 Tsao R. & Zhou T. (2000). Antifungal activity of monoterpenoids against postharvest pathogens *Botrytis cinerea* and *Monilinia fructicola. Journal of Essential Oil Research* **12**:113 - 121.

5 Goubran F.H. & Holmes R.J. (1997). *Natural alternatives for the control of postharvest rots in citrus.* pp. 10-69. Institute for Horticultural Development (IHD), Victoria, Australia.

6 Baruah P., Sharma R .K., Singh S. & Ghosh C. (1998). Fungicidal activity of some naturally occurring essential oils against *Fusarium moniliforme. Journal of Essential Oil Research* **8**: 411- 412.