QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 699

ETHYLENE PRODUCTION BY COLLETOTRICHUM MUSAE

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SUMMARY

Ethylene gas is shown to be a metabolic product of *Colletotrichum musae* (Berk. and Curt.) Arx, a banana pathogen. The possible significance of ethylene production by this fungus to host-pathogen relations in the banana is discussed.

I. INTRODUCTION

Ethylene is a metabolic product of healthy, undamaged plant tissues (Burg 1962) and also of many fungi, including plant pathogens, in axenic culture (Ilag and Curtis 1968, Pratt and Goeschl 1969). When both host and pathogen are involved, it is difficult to establish whether the gas is produced by the host tissue, or by the pathogen itself. Williamson (1950) investigated several host-pathogen combinations which produced more ethylene than the healthy hosts alone, and concluded that the extra ethylene was most likely produced by the host-tissue in response to injury by the pathogens. The possible importance of ethylene in influencing translocation in diseased tissues has been suggested by Yarwood (1967), and Ilag and Curtis (1968) state that ethylene produced by fungi should be considered in studies of growth disturbances of plants.

With particular reference to the banana, at least four diseases can cause earlier ripening than would occur in healthy fruit. The pathogens are *Colletotrichum musae* (Peacock 1973), *Thielaviopsis paradoxa* (Wardlaw and McGuire 1931), *Botryodiplodia theobromae* (Wardlaw and McGuire 1932) and *Pseudomonas solanacearum* (Freebairn and Buddenhagen 1964). Mechanical wounding also causes earlier ripening (Maxie et al 1968). However *P. solanacearum* can produce ethylene in vitro (Freebairn and Buddenhagen 1964) and these authors suggest that ethylene from the pathogen may significantly influence the host-pathogen relationships. The following investigation was therefore conducted to find whether *C. musae* could also produce ethylene in vitro, as this does not appear to have been investigated previously.

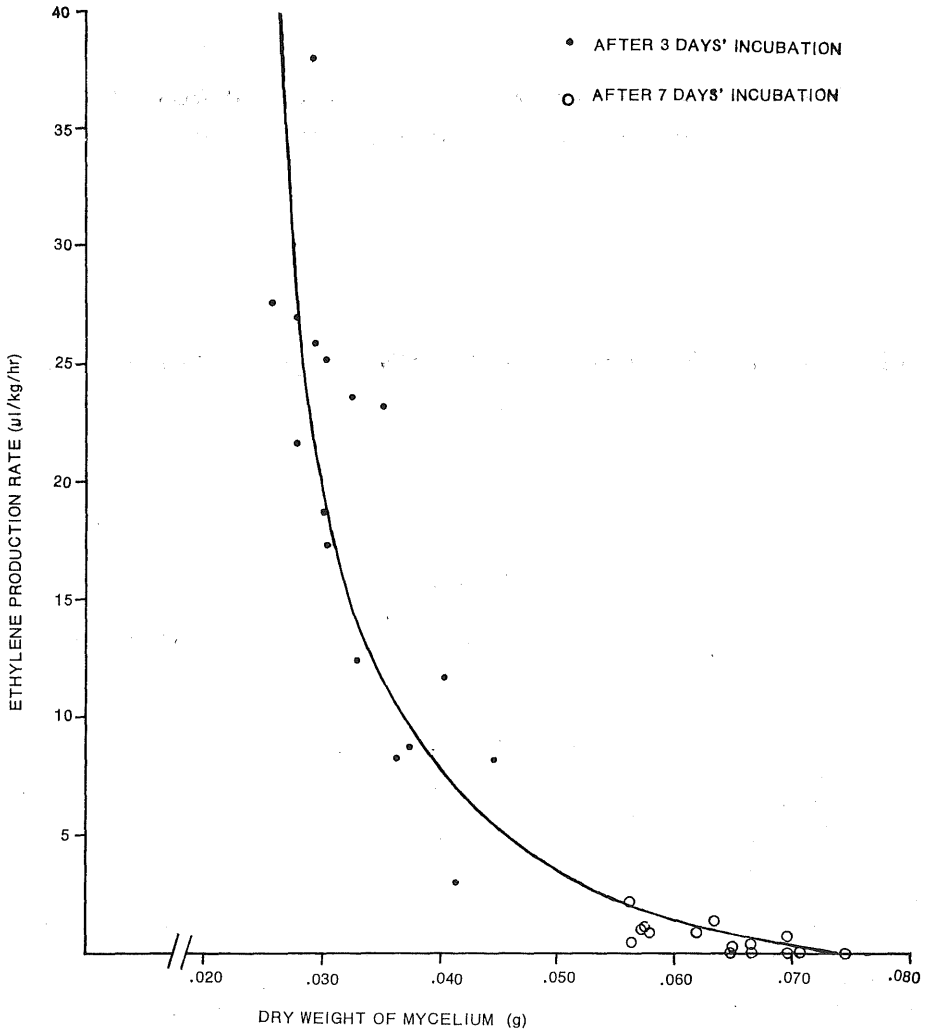

Figure I.—The relationship of dry weight of mycelium to ethylene production rate.

II. MATERIALS AND METHODS

Cultures of *C. musae* were grown in 25 ml flasks with aluminium foil caps containing 10 ml of potato dextrose broth. Each flask was inoculated with one drop of a spore suspension prepared from a 7-day-old culture and incubated at 25–26°C in a water bath as a shake culture. The experiment was carried out on two separate occasions with different incubation periods of 3 and 7 days. Sixteen flasks were used for each experiment. At the conclusion of the incubation period, the culture vessels were flushed with ethylene-free air and sealed with a rubber septum for periods of 3 to 4 hours at 20°C. Air samples were then removed using a gas syringe, and were examined using an Aerograph gas chromatograph equipped with a flame ionisation detector and an aluminium

oxide column. Uninoculated broth was also incubated and tested to check whether, under the conditions of incubation, ethylene was produced by some chemical reaction within the medium. Dry weights of fungus in the culture vessels were determined after filtration, thorough washing and vacuum drying at 75°C.

Ethylene was identified as a component of the air samples by comparison of retention time with that for pure ethylene and by demonstrating that the suspect component could be absorbed by bromine water. An artificial gas mixture was used as a standard to ensure that ethylene and ethane were clearly separated under the conditions of chromatography, thus avoiding any possible confusion between these two substances in the test samples.

III. RESULTS

The dry weights of mycelium and ethylene production rates obtained after 3 and 7 days' incubation are illustrated graphically in Figure 1. Ethylene production rates after 3 days' incubation are significantly higher ($p<0\cdot001$) than after 7 days' incubation. A significant negative correlation exists between the measured production rates and the dry weight of the fungus in both the 3-day (correlation coefficient $0\cdot797$, $p<0\cdot001$) and the 7-day (correlation coefficient $0\cdot688$, $p<0\cdot01$) samples. When the results of both experiments are combined, the relationship between the yield of ethylene and the weight of mycelium over a range of fungal growths decreases exponentially.

IV. DISCUSSION

The above results demonstrate that *C. musae* produces ethylene in axenic culture. The decline in ethylene production rate with increasing mycelial mass suggests that ethylene production is mainly associated with the active stage of the growth of the fungus.

The host-pathogen relationships of the banana and *C. musae* are closely associated with the ripening processes. Although infections can be formed in green fruit, these remain latent until ripening occurs (Simmonds 1941). However, if the green fruit is damaged, the infection may resume activity and cause a wound lesion (Meredith 1960). Simmonds (1963) suggested that ethylene produced by the wounded green tissue could lead to localized conditions similar to those occurring in ripe fruit. If *C. musae* itself produces ethylene as it begins to grow in the wounded tissue, it could hasten the localized ripening process and therefore contribute to its own growth and lesion development. Ethylene production by *C. musae* in the fruit could also explain the reduction of green-life reported by Peacock (1973).

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(Received for publication 9 August 1974)

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