

PRELIMINARY REPORTS

Ethylene Production in Xanthi Tobacco after Systemic and Local Virus Infections

By

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Using a single tobacco variety (Xanthi-nc) and two viruses (TMV and CMV) as test organisms, ethylene production was compared in the same host after local and systemic infections, respectively. Ethylene production was increased markedly in local lesion infections at the very beginning of tissue necrosis, whereas ethylene production did not change perceptively in systemic infections.

Introduction

Recently, ample evidence has accumulated to show that ethylene may be regarded as the hormone of tissue senescence (HALLAWAY and OSBORNE, 1969, GALSTON and DAVIES, 1969). Necrotic spots induced in tissues by viral infections on local lesion hosts could be the consequence of enhanced local senescence of leaf tissues. This latter hypothesis stems from the finding that virus-induced local lesions are suppressed if juvenility is promoted, and lesion development is promoted if tissue senescence is enhanced in host plants (KIRÁLY, EL HAMMADY and POZSÁR, 1968).

Ethylene production is a well established fact in plant tissues infected by certain bacterial and fungal pathogens (FREEBAIRN and BUDDENHAGEN, 1964, STAHMANN, CLARE and WOODBURY, 1966, CHALUTZ and DeVAY, 1969). The view was expressed as early as 1951 that virus infections too produce "physiologically active emanations", which ROSS and WILLIAMSON (1951) regarded as being probably ethylene. In addition, STAHMANN (1968) noted in the addendum to his paper, presented with co-workers at the International Symposium held in Tokyo on Plant Biochemical Regulation in Viral and Other Diseases or Injury, that local lesion hosts (two species) for tobacco mosaic virus produced more ethylene after infection than a systemic host (another species) for the same virus. He compared detached leaves of these three plant species, but detailed data were not presented.

We have infected a *single host variety* and have induced in *intact plants* both local lesion infections and systemic infections using two different viruses. This procedure avoids the inherent differences in the ethylene production in different host species or even varieties and the well known difficulty with ethylene production of detached senescing leaves. By infecting the same host with two viruses we

obtained both compatible and incompatible host-pathogen interactions, thus ruling out the differences in ethylene production that could exist independently of the virus infection.

Materials and Methods

Nicotiana tabacum L. var. Xanthi-nc was grown under ordinary greenhouse conditions and used for experiments in the 10-leaf-stage. Infecting attached leaves of Xanthi plants with tobacco mosaic virus (TMV), strain UI, we obtained local lesion infections. With cucumber mosaic virus (CMV), yellow strain, we induced a systemic infection in the same host.

Ethylene production was determined at the time of symptom expressions: at 1—5 days after inoculation in the case of local lesion infections, and at the 10—15 days after inoculation with the systemic virus. Plants were removed from soil and put into a nutrient solution in bell jars (1.5 litre) with removable covers fitted with a two-hole rubber stopper. The ethylene was collected from a moving gas stream in 0.25 M mercuric perchlorate in 2M HClO₄ (YOUNG, PRATT and BIALE, 1952), and was analyzed by gas chromatography after releasing the ethylene by the addition of 2N hydrochloric acid. Comparative ethylene productions were related to unit leaf surfaces. The results of five experiments were recorded.

Results and Discussion

As can be seen in Fig. 1, ethylene production of the host plant was not influenced by virus infection if the host-pathogen relation was a compatible one, as in the case of systemic infections. However, ethylene production was enhanced in the same host, in the incompatible host-pathogen interaction, exhibiting local lesion symptoms. The data presented in Fig. 2 show about hundred per cent increase in ethylene production. This was experienced on the third day after infection, and it coincided with the time of the appearance of local lesions. On the fifth day, ethylene production decreased to the level, or sometimes under the level, of the uninfected control. This probably is the result of a considerable portion of the leaf becoming necrotic with the full development of the lesions.

In another experiment the Xanthi variety was the local lesion host and the Samsun variety was the systemic host. Both were infected with the same virus, TMV. In this case too, enhanced ethylene production was induced only in Xanthi plants (in the local lesion host). These results were similar to the representative one presented in Figs 1 and 2.

Conducting the above experiments, we obtained in most cases continuously increasing ethylene production, even with the uninfected healthy plants (see both figures but particularly Fig. 2). One can suppose that they became somewhat senescent during the 5—6 days they were under the bell jars with high humidity and

insufficient light. To avoid these possibly disturbing factors, we arranged another series of experiments. In this, Xanthi tobacco plants, infected with CMV and TMV, were investigated for ethylene production only for 12 hrs at different times after infection. Thus, plants remained only for 12 hrs under such unnatural conditions. We infected a series of uniform plants in the greenhouse and took samples at 12, 24, 36, 48, 60, 72, 84 and 96 hrs after infection. These results will be published in detail in another paper, but it is of interest here to mention that an enhancement

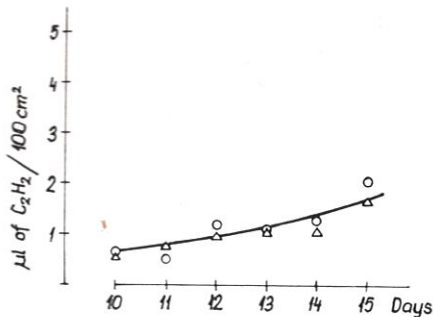


Fig. 1. Ethylene production of Xanthi tobacco plants systemically infected with cucumber mosaic virus (○) and non-infected healthy plants (Δ)

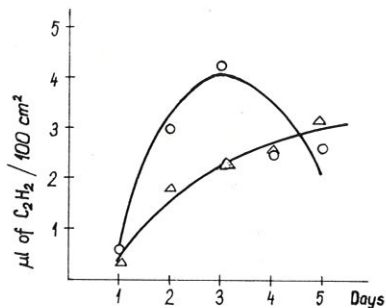


Fig. 2. Ethylene production of Xanthi tobacco plants infected with tobacco mosaic virus causing local lesions (○) and non-infected healthy plants (Δ)

of ethylene production was experienced 36 hrs after infection only in the local lesion host. At this time, local lesions were very small and tissue necrosis was at a minimum.

It would seem that the enhanced ethylene production takes place somewhat before tissue necrosis. However, more research is needed to decide whether tissue necrosis is the consequence of enhanced ethylene production or that necrosis is the cause of enhanced ethylene production.

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