

## A YELLOW RINGSPOT STRAIN OF TOBACCO MOSAIC VIRUS (TMV) FROM TOMATO<sup>1</sup>

*Een gele-kringvlekkenstam van het tabaksmosaïekvirus van tomaat*

A. TH. B. RAST<sup>2</sup>

Institute of Phytopathological Research (I.P.O.), Wageningen

During a two years' survey of TMV-strains occurring in tomato in the Netherlands many tomato leaf-samples were investigated for their virus content. From each sample twenty single lesions produced on *Nicotiana tabacum* 'Xanthi nc' were isolated and inoculated both to *N. tabacum* 'Samsun' for multiplication and to the "necrotic" line of *N. tabacum* 'White Burley' for a preliminary classification into tobacco and/or tomato type TMV (TERMOHLEN & VAN DORST, 1956; ALEXANDER, 1962). Dependent on symptom development on these hosts one, two or three of these isolates were selected to start new series of ten single lesion isolates each, which were then tested separately on *Petunia hybrida* (cf. MACNEILL, 1962) and *N. rustica*. These two indicator hosts react to the tomato type TMV as does the "necrotic" line of 'White Burley'. If necessary the single lesion isolation was repeated until consistent symptoms were obtained.

Taking account of the systemic symptoms produced on tomato and tobacco on the one hand and the reaction of the above-mentioned indicator hosts on the other hand, it is possible to distinguish at least five strains of TMV. Four of these have been more or less extensively described in the past (SMITH, 1957; BROADBENT, 1961); the symptoms caused by the fifth strain, however, do not fit the description of any of these four. The present communication gives a brief description of the symptoms caused by this fifth strain on a number of host plants and of other properties confirming its relationship with TMV.

Symptoms on *Lycopersicum esculentum* 'Moneymaker' are very slow to develop. Inoculated leaflets hardly show any symptoms and it is only after two weeks that the first signs of systemic infection become visible on young unfolding leaves. Tiny yellow dots appear, mainly along the veinlets, giving an effect of vein yellowing. Occasionally ringspot effects (see Fig. 1A) are observed as a final result on the fully expanded leaves. On the next couple of leaves the yellowing spreads between the veins, except on the terminal leaflets where it tends to remain restricted to an irregular band along the main veins only. The yellow colour turns to a dull white on the maturing leaves which, in addition, show a slight narrowing. On still higher leaves a yellow mosaic develops which cannot be distinguished from that caused by common yellow strains of TMV. Fruits, as a rule, are not affected but some may show faint yellowish spots which, however, completely disappear on ripening.

Leaves of 'Samsun' tobacco show, within a week of inoculation, lesions the colour of which lies between that of the chlorotic lesions caused by common green strains of TMV and that of the bright yellow lesions caused by the aucuba

<sup>1</sup> Accepted for publication 13 January, 1965.

<sup>2</sup> Stationed at the Horticultural Experiment Station, Naaldwijk.

strain. The development of systemic symptoms is initially similar to that on tomato. However, instead of a common yellow mosaic, distinct greenish-yellow ringspots (see Fig. 1B.) are continuously produced between the veins, their numbers decreasing on successive leaves until flowering begins.

Yellow ringspots of similar type were observed on *N. glauca* (see Fig. 1D), *N. paniculata* and an undetermined narrow-leaved variety of *N. tabacum*. On the "systemic" line of 'White Burley' tobacco the ringspots are less conspicuous than on 'Samsun'. On *N. clevelandii* (see Fig. 1C) necrotic rings appear both as local and systemic symptoms. In addition a severe chlorosis and twisting of the youngest leaves occur. The virus strain under discussion will henceforth be referred to as the ringspot strain.

The relationship of the ringspot strain to TMV was confirmed by a positive serological reaction with the TMV antiserum commonly used at the Institute of Phytopathological Research. A preparation of the ringspot strain, made according to the dip method, revealed under the electron microscope the presence of rod-shaped particles which could not be distinguished from those of tobacco type TMV.

The inactivation temperature and the dilution end-point were determined applying the methods proposed by BOS, HAGEDORN & QUANTZ (1960) and using *N. glutinosa* plants for assay. For these experiments leaf sap was prepared from tomato plants which had been inoculated one month previously. The ringspot strain was inactivated at temperatures between 87° and 90°C, whereas tobacco type TMV in the same experiment was not completely inactivated at a temperature of 93°C. The dilution end-point for the ringspot strain was between  $10^{-5}$  and  $10^{-6}$  as compared with that of tobacco type TMV for which this value was between  $10^{-6}$  and  $10^{-7}$ . The ringspot strain produces local lesions similar to those of the tomato type TMV on the "necrotic" line of 'White Burley' tobacco, *N. rustica*, *N. sylvestris*, *N. longiflora*, *Petunia hybrida* and *Physalis ixocarpa*. Since the tobacco type of TMV causes a systemic infection of these hosts, it is concluded that the ringspot strain is a tomato type TMV.

To investigate the relationship between the ringspot strain and tobacco type TMV, cross-protection experiments were performed using *N. sylvestris* and the "necrotic" line of 'White Burley' as test plants. In these experiments the inoculation with tobacco type TMV, which served as the protecting strain, was followed by a second inoculation with the ringspot strain on the same leaves after different intervals of time. While a period of seven days between both inoculations proved to be insufficient to prevent the formation of local lesions, these failed to appear when ten days had passed.

Although the evidence presented above leaves no doubt as to the TMV-nature of the ringspot strain, the question of its identity still remains to be answered. The "tomato black fleck strain" of TMV (HOLLINGS, 1959a) was reported to cause local necrotic ring lesions on *N. clevelandii* (HOLLINGS, 1959b). However, as no mention was made of a yellow mosaic resulting from a systemic infection of tomato the ringspot strain may not be the same as the "black fleck strain". The ringspot strain described by SMITH (1957) is characterized by the development of local necrotic rings and oakleaf patterns with strongly necrotic edges on tobacco 'Samsun'. The ringspot strain described in this paper was never observed to cause appreciable necrosis on 'Samsun nn'; it produced only solid necrotic lesions without systemic spreading on 'Samsun NN' and is

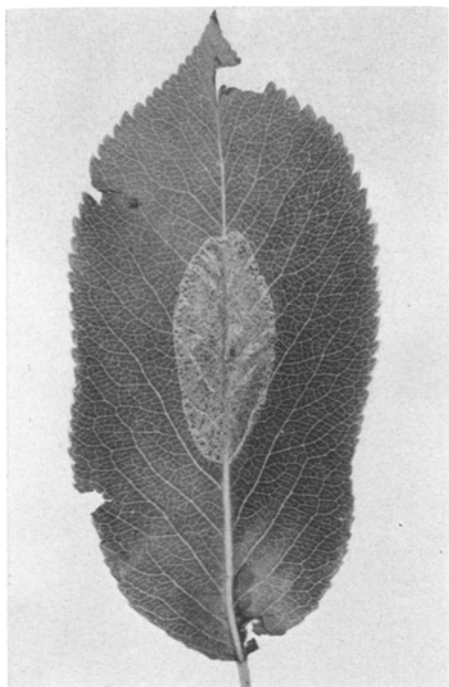


FIG. 1. Zommijn van *Lithocolletis corylifoliella* op peer.  
Summer leaf mine of *Lithocolletis corylifoliella* on pear.

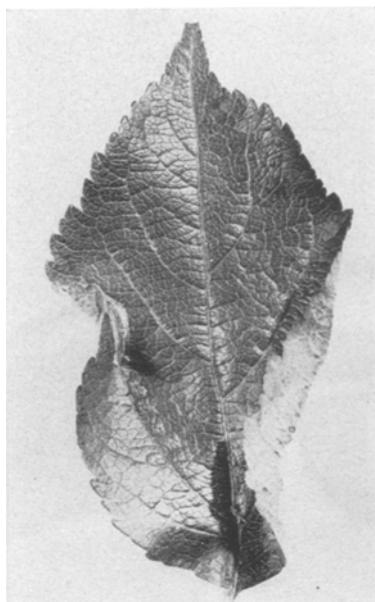


FIG. 2. Overwinteringsmijn van *Lithocolletis corylifoliella* op appel.  
Hibernating mine of *Lithocolletis corylifoliella* on apple.



FIG. 3. Geopende mijn van *Lithocolletis corylifoliella* op appel met typische „secondaire” mijn.  
Dissected leaf mine of *Lithocolletis corylifoliella* on apple with typical „secondary” mine.



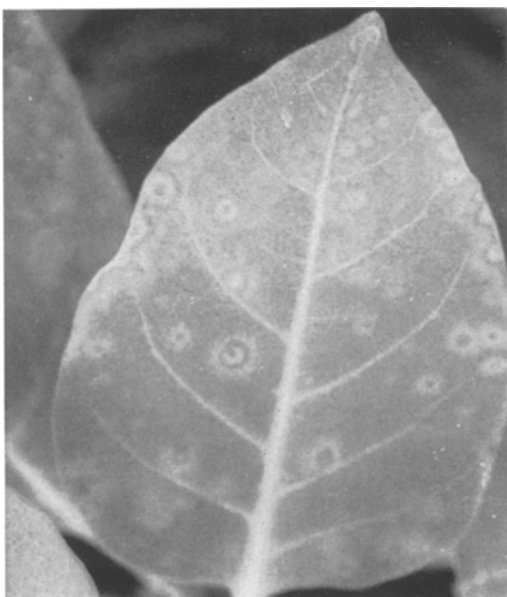
A



B



C



D

FIG. 1. A. Tomato leaflet with yellow ringspots.  
 B. Leaf of 'Samsun'-tobacco with yellow ringspots.  
 C. Leaves of *Nicotiana clevelandii* with yellow primary lesions surrounded by necrotic rings.  
 D. Leaf of *Nicotiana glauca* with yellow ringspots.  
 A. Blaadjes van tomaat met gele kringvlekken.  
 B. Blad van 'Samsun'-tabak met gele kringvlekken.  
 C. Bladeren van *Nicotiana clevelandii* met primaire gele lesies, omgeven door necrotische kringen.  
 D. Blad van *Nicotiana glauca* met gele kringvlekken.

therefore clearly different from the one described by SMITH (1957: 519). As no other objectives for comparison suggested themselves from the literature it was concluded that the strain here investigated has hitherto remained unnoticed. To avoid confusion, it is suggested that it should be named the "tomato yellow ringspot strain of TMV".

#### ACKNOWLEDGEMENTS

The author is greatly indebted to Miss Drs. F. QUAK for encouragement and invaluable criticism and suggestions. He also wishes to thank Miss Drs. C. VAN DER SCHEER and her staff of the Service Institute for Applied Mechanics and Technical Physics in Agriculture for making electron micrographs, Mr. D. Z. MAAT for performing the serological test and Ir. T. S. IE for performing an indispensable inoculation. The author is grateful to Miss L. VAN DER MEER for technical assistance and Mr. L. BOL and Mr. W. MUYZENBURG for making the photographs.

#### SAMENVATTING

Er wordt een korte beschrijving gegeven van de symptomen op tomaat, tabak en andere waardplanten (fig. 1), veroorzaakt door een blijkbaar onbekende stam van het tabaksmozaïekvirus (TMV). Er werden proeven gedaan om de verwantschap met tabakstype TMV vast te stellen. Er wordt een poging tot identificatie met andere stammen ondernomen.

#### REFERENCES

- ALEXANDER, L. J., - 1962. Strains of TMV on tomato in the Netherlands and in Ohio, U.S.A. Meded. LandbHogesch., Gent 27: 1020-1030.
- BOS, L., J. D. HAGEDORN & L. QUANTZ, - 1960. Suggested procedures for international identification of legume viruses. Tijdschr. PlZiekt. 66: 328-343.
- BROADBENT, L., - 1961. The epidemiology of tomato mosaic I. A review of the literature. Ann. Rep. Glasshouse Crops Res. Inst., Littlehampton 1960: 96-116.
- HOLLINGS, M., - 1959a. Host range studies with fifty-two plant viruses. Ann. appl. Biol. 47: 98-108.
- HOLLINGS, M., - 1959b. *Nicotiana clevelandii* Gray as a test plant for plant viruses. Plant Pathol. 8: 133-137.
- MACNEILL, B. H., - 1962. A specialized form of the tomato mosaic virus in Canada. Canad. J. Bot. 40: 49-51.
- SMITH, K. M., - 1957. A textbook of plant virus diseases. 2nd ed., J. & A. Churchill, London.
- TERMOHLEN, G. P. & H. J. M. VAN DORST, - 1956. Verschillen tussen *Lycopersicum virus 1* en *Nicotiana virus 1*. Proefsta. Groenten- en Fruitteelt onder Glas, Naaldwijk, Jaarversl. 1958: 125-126.