

## Pak-Choy as natural host of turnip yellow mosaic virus in Hungary

### Pak-Choy als neuer natürlicher Wirt des turnip yellow mosaic virus in Ungarn

J. HORVÁTH

University of Agricultural Sciences, Institute for Plant Protection, H-8361 Keszthely,  
P.O. Box 71, Hungary

D. MAMULA and N. JURETIĆ

University of Zagreb, Institute of Botany, YU-41000 Zagreb, Marulicev trg 20/II, Yugoslavia

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#### Summary

Turnip yellow mosaic virus (TYMV) was found to naturally infect Pak-Choy (*Brassica campestris* var. *chinensis*) plants in Hungary. The virus isolated from Pak-Choy (isolate PC) caused pronounced vein clearing, vein yellowing, outstanding variegation and bright yellow mosaic symptoms in those plants. TYMV-PC was studied by means of test plants, light microscope, as well as serologically. Cruciferous test plants responded with vein clearing and bright yellow mosaic symptoms on leaves following inoculation with isolate PC, a reaction characteristic of TYMV. In cruciferous test plants, isolate PC caused plastid alterations typical of TYMV infection, consisting of clumping, swelling, vacuolating and disrupting of plastids. In serological agar gel double diffusion experiments with antiserum against a Yugoslav TYMV isolate (TYMV-Y65), isolate PC was proved to belong to TYMV.

This is the first report on TYMV in Pak-Choy.

**Key words:** *Brassica campestris* var. *chinensis*; turnip yellow mosaic virus; symptoms; inclusion bodies; serology

#### Zusammenfassung

Turnip yellow mosaic virus (TYMV) infiziert Pak-Choy (*Brassica campestris* var. *chinensis*, Sorte 'Japro RS-2781') in Ungarn spontan. Das Virusisolat PC verursachte auf diesen Pflanzen eine deutliche Adernaufhellung, Adernvergilbung, Buntfarbigkeit und Symptome eines hellen Gelbmosaiks. Das TYMV-Isolat PC wurde mit Hilfe von Testpflanzen, lichtmikroskopisch sowie serologisch untersucht. Cruciferen als Testpflanzen reagierten mit Adernaufhellung und hellgelben, für TYMV typischen Mosaiksymptomen; ferner verursachte das Isolat PC des TYMV Plastidveränderungen in Form der Verklumpung, Anschwellung, Vakuolisierung bis zur Zerstörung der Plastiden. Mit Hilfe eines Antiserums gegen ein jugoslawisches Isolat Y65 des TYMV wurde serologisch im Agargel-Doppeldiffusionstest bestätigt, daß das Isolat PC dem TYMV zuzuordnen ist.

Dies ist der erste Bericht über das TYMV an Pak-Choy.

**Stichwörter:** *Brassica campestris* var. *chinensis*; turnip yellow mosaic virus; Symptome; Einschlußkörper; Serologie

## 1 Introduction

Turnip yellow mosaic virus (TYMV, tymovirus group; MATTHEWS 1980) has been found so far to infect in nature altogether 22 or 23 cruciferous plant species, varieties and cultivars. Susceptibility of plants – cruciferous and non-cruciferous ones alike – to the virus after artificial inoculation has been studied fairly extensively especially by BROADBENT and HEATHCOTE (1958) and by HORVÁTH (1979). Beyond natural hosts, additional 63 or 64 crucifers belonging to 31 genera, which include a few *Brassica* cultivars, were found to be susceptible to the virus (BROADBENT and HEATHCOTE 1958, MAMULA 1968, HORVÁTH 1979, THORNBERY 1966). Outside the family Cruciferae, it seems that only *Cleome spinosa* L. and *Reseda odorata* L. (MATTHEWS 1980, MAMULA 1968) and *Nicotiana tabacum* L. cv. 'Xanthi' (MATTHEWS and RALPH 1966) could be infected with TYMV.

TYMV is known to have spread only in Europe, in 12 countries predominantly of Central- and South Europe (MAMULA and JURETIC 1985). These data include a former finding of the virus in Hungary, too (JURETIC et al. 1973, HORVÁTH et al. 1973). Now we are reporting on finding TYMV in Hungary on Pak-Choy plants unknown so far as natural host of the virus.

## 2 Materials and methods

In the summer of 1985, *Brassica campestris* L. var. *chinensis* (Pak-Choy cv. 'Japro RS 2701') plants suspected to be virus infected were found in the field of the Early Vegetable Production System of Szentes, Hungary. The naturally infected plants showed pronounced vein clearing, vein yellowing, outstanding variegation and bright yellow mosaic symptoms (Fig. 1A).

Inocula were prepared by grinding Pak-Choy leaves with phosphate buffer (0.15 mol/l, pH 7.0) at a ratio of 1:1 (v/v). This was rubbed on various test plants (see Table 1) by conventional spatule technique using 400 mesh carborundum.

The influence of the isolate from Pak-Choy (isolate PC) on plant cells was analyzed by a light microscope. The observations were carried out on tissue sections taken from midrib on



Fig. 1. Symptoms caused by PC isolate of turnip yellow mosaic virus (TYMV) on naturally (A) and artificially (B) infected leaves of Pak-Choy (*Brassica campestris* var. *chinensis*) plants.

Abb. 1. Symptome, verursacht vom PC-Isolat des turnip yellow mosaic virus (TYMV) an natürlich (A) und künstlich (B) infizierten Blättern von Pak-Choy-Pflanzen. (*Brassica campestris* var. *chinensis*).

Table 1. Susceptible and insusceptible plants of PC isolate of turnip yellow mosaic virus (TYMV) from Pak-Choy  
 Tab. 1. Anfällige und resistente Pflanzen gegenüber dem PC Isolat von turnip yellow mosaic virus (TYMV) aus Pak-Choy

Susceptible plants:

*Brassica adpressa* Boiss

*B. campestris* L. em. Hartm.

*B. campestris* L. var. *chinensis*

*B. carinata* A. Braun

*B. nigra* Koch

*B. pekinensis* Rupr.

*B. rapa* L. var. *rapa*

*Bunias orientalis* L.

*Crambe abyssinica* Hochst. ex R. E. Frees

*C. armena* N. Bush

*C. cordifolia* Stev.

*C. maritima* L.

Insusceptible plants:

*Chenopodium amaranticolor* Coste et Reyn.

*C. quinoa* Willd.

*Cucumis sativus* L.

*Datura stramonium* L.

*Nicotiana glutinosa* L.

*N. tabacum* L. cv. 'Xanthi-nc'

the lower surface of systemically infected leaves of naturally infected Pak-Choy plants and of experimentally infected Pak-Choy and turnip plants (*Brassica rapa* L. var. *rapa*). Details of the procedure are given by JURETIĆ et al. (1973).

Serological experiments were performed by means of double radial diffusion technique, i. e., by spur test and intragel cross absorption test, in a gel medium containing 1 % Difco bacto agar and 0.05 %  $\text{NaN}_3$  in physiological saline. For comparison purposes, the Hungarian and Yugoslav isolates H2 and Y65, respectively, were used. Viral antigens were applied in the form of low-speed centrifuged mechanical extracts of systemically infected leaves of Pak-Choy plants infected either naturally or artificially (isolate PC), and of artificially infected turnip plants (isolates H2 and Y65). An antiserum prepared against isolate Y65 was used (JURETIĆ et al. 1973).

### 3 Results

The isolate PC obtained from Pak-Choy plants proved to be readily transmissible to several cruciferous plants (Table 1). The susceptible plants responded with typical vein clearing and bright yellow mosaic symptoms (Fig. 2A and B). Pak-Choy (cv. 'Japro RS 2701') showed the



Fig. 2. Symptoms on *Brassica campestris* (A) and *Crambe abyssinica* (B) test plants inoculated with turnip yellow mosaic virus (TYMV).

Abb. 2. Symptome an den Indikatorpflanzen *Brassica campestris* (A) und *Crambe abyssinica* (B), die mit turnip yellow mosaic virus (TYMV) infiziert waren.

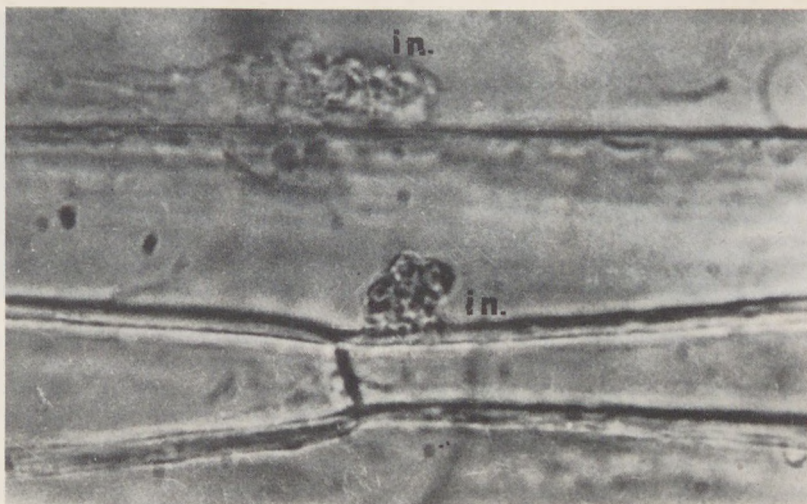


Fig. 3. Leaf cells of turnip (*Brassica rapa*, var. *rapa*) plant experimentally infected with PC isolate of turnip yellow mosaic virus (TYMV) containing inclusion bodies (in) composed mainly of altered plastids. Magnification: c. 1000x.

Abb. 3. Blattzellen einer experimentell mit dem PC-Isolat des turnip yellow mosaic virus (TYMV) infizierten Kohlrübenpflanze (*Brassica rapa*, var. *rapa*) mit Einschlusskörpern (in), die sich hauptsächlich aus veränderten Plastiden zusammensetzen. Vergrößerung: ca. 1000x.

same type of symptoms after mechanical inoculation as the naturally infected field plants (Fig. 1B). Some other test plants (Table 1) were not susceptible to the isolate PC. The typical reaction of the cruciferous plants indicated that isolate PC from Pak-Choy was very similar to or identical with TYMV (JURETIĆ et al. 1973, HORVÁTH et al. 1973).

In epidermal and subepidermal leaf cells of infected plants, we found swollen and vacuolated plastids which were clumped together and formed inclusion bodies of alveolar appearance (Fig. 3). In experimentally infected plants, this was visible one to several weeks after the appearance of systemic symptoms.

Leaf sap of Pak-Choy plants infected naturally or experimentally with isolate PC gave positive serological reaction with antiserum to isolate Y65 (Fig. 4A). In several experiments, isolate Y65 gave a spur of rather low intensity over the precipitation line of isolate PC (Fig. 4B). This was confirmed in intragel cross absorption experiments (Fig. 4C). When isolates PC and H2 were compared by means of antiserum to isolate Y65, no spur formation was observed.

#### 4 Discussion

Light microscope observations gave the first indication that the investigated disease of Pak-Choy plants was due to infection by a tymovirus (KOENIG and LESEMANN 1981, JURETIĆ et al. 1973). These observations (together with test plant reactions) showed that none of the viruses other than tymoviruses known to infect cruciferous plants naturally (ŠTEFANAČ 1967, SHUKLA and SCHMELZER 1972, 1975) was present in naturally infected Pak-Choy plants. In addition, the absence of necrotic lesions in inoculated leaves of *Brassica napus* var. *napobrassica* showed that *Erysimum* latent virus (SHUKLA and SCHMELZER 1972, SHUKLA and GOUGH 1980), a tymovirus serologically unrelated to TYMV which infects cruciferous plants, was not contained in Pak-Choy plants. Precise demonstration of a causal virus was achieved in serological experiments.

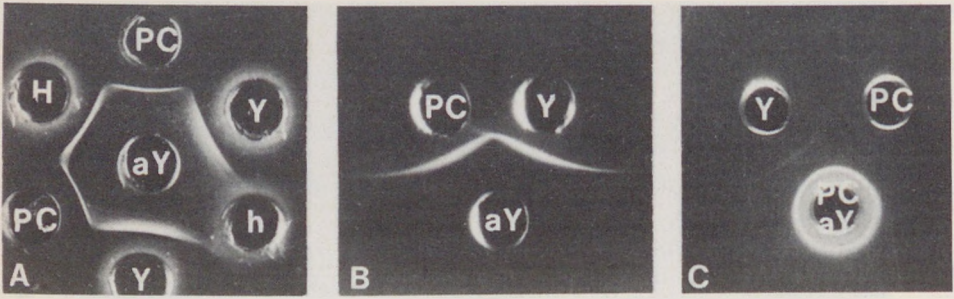


Fig. 4. Serological reactions of PC isolate of turnip yellow mosaic virus (TYMV) from Pak-Choy plants. A: Identification of PC isolate by means of antiserum aY. Antiserum dilution 1:2. B: Spur experiment. C: Intragel cross absorption experiment. B and C: Antiserum (aY) undiluted; Yugoslavian turnip yellow mosaic virus isolate Y65 (Y), Hungarian turnip yellow mosaic virus isolate H2 (H), antiserum to Y65 isolate (aY) and healthy plant sap (h).

Abb. 4. Serologische Reaktionen mit dem PC-Isolat des turnip yellow mosaic virus (TYMV) von Pak-Choy-Pflanzen. A: Identifizierung des PC-Isolates mit Hilfe des Antiserum aY. Antiserumverdünnung 1:2. B: Sporn-Test. C: Intragel-Cross-Absorption Versuch. B und C: Antiserum (aY) unverdünnt; turnip yellow mosaic virus, jugoslawisches Isolat Y65 (Y); turnip yellow mosaic virus, ungarisches Isolat H2 (H), Antiserum gegen Isolat Y65 (aY) und gesunder Pflanzensaft (h).

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