Viruses affecting some bulb and corm flower crops

M. Navalinskienė,
M. Samuitienė

Plant Virus Laboratory,
Institute of Botany,
Žaliųjų ežerų 49,
LT-2021, Vilnius, Lithuania

Eleven viruses were isolated and identified from bulb and corm flower crops widely grown in Lithuania. Viruses were identified by test-plant and electron microscopy methods. *Cucumber mosaic cucumovirus* (CMV) was identified in *Crocus* L., *Lilium* L., *Muscari* Mill., *Narcissus* L., *Hyacinthus mosaic potyvirus* (HyaMV) – in *Hyacinthus* L., *Iris mild mosaic potyvirus* (IMMV) – in *Crocus* L., *Lily mottle potyvirus* (LMoV) and *Lily symptomless carlavirus* (LSV) – in *Lilium* L., *Muscari mosaic potyvirus* (MMV) – in *Muscari* Mill., *Narcissus mosaic potexvirus* (NMV) and *Narcissus yellow stripe potyvirus* (NYSV) – in *Narcissus* L., *Tobacco rattle tobravirus* (TRV) – in *Crocus* L., *Lilium* L., *Muscari* Mill., *Narcissus* L., *Tomato ringspot nepovirus* (ToRSV) – in *Lilium* L., *Narcissus* L., *Tomato spotted wilt tospovirus* (TSWV) – in *Lilium* L. Symptoms on naturally infected plants have been described and virus particle morphology established. The MMV was purified and the antigene prepared.

Key words: bulb flowers, corm flowers, viral diseases, virus identification

INTRODUCTION

Bulb and corm flowers as popular verdure plants, cut flowers, commercial crops have been grown in Lithuania for many years. Most prevalent bulb crops are *Tulipa* L., *Lilium* L. (*Liliaceae* Juss.), *Narcissus* L. (*Amaryllidaceae* J. St.-Hil.), *Hyacinthus* L., *Muscari* Mill. (*Hyacinthaceae* Batsch ex Borkh.), *Crocus* L., *Gladiolus* L. (*Iridaceae* Juss.). Data on viruses affecting very important bulb crops *Tulipa* L. and *Gladiolus* L. have been presented in reports [1, 2].

Ornamental plants suffer considerable losses due to virus infection. Virus diseases reduce the aesthetic quality and marketability of ornamental plants. Viruses survive in infected bulbs and corms and spread due to vegetative propagation by them, are transmitted by vectors.

MATERIALS AND METHODS

Material for investigation was collected in different floriculture farms and private flower collections in Lithuania. Samples were collected from flowers showing visual virus symptoms. The experimental work was carried out at the greenhouse and Plant Virus Laboratory of the Institute of Botany. Virus has been identified by electron microscopy negative staining technique [3, 4] and test-plant method. The following test-plants were inoculated: *Amaranthus caudatus* L., *A. paniculatus* L., *Atriplex hortensis* L., *Celosia argentea f. cristata* (L.) Kuntze, *Chenopodium amaranticolor* Coste et Reyn, *C. ambrosioides* L., *C. murale* L., *C. quinoa* Willd., *C. urbicum* L., *Cucumis sativus* L. *Datura stramonium* L., *Gomphrena globosa* L., *Lycopersicon esculentum* Mill., *Nicandra physalodes* (L.) Gaertn., *Nicotiana debneyi* Domin., *Nicotiana glutinosa* L., *N. tabacum* L. 'Samsun', 'White Burley', 'Xanthi', *N. rustica* L., *Petunia hybrida* Vilm., *Phaseolus vulgaris* L., 'Baltija', 'Prince', *Tetragonia expansa* Murr., *Trifolium incarnatum* L. The inoculum for mechanical inoculation was prepared by homogenizing infected leaves with 0.1 M phosphate buffer (pH 7.0), containing 0.2% 2-mercaptoethanol or 0.01 M sodium diethyldithiocarbamate, 0.1% thioglycolic acid. MMV purification was carried out according to a selected method [5].

RESULTS AND DISCUSION

A many-year investigation of virus diseases of ornamental plants revealed that bulb and corm flowers are affected by a great number of viruses. Eleven viruses were isolated and identified in those most popular.

Cucumber mosaic cucumovirus (CMV) was identified in *Crocus* L., *Lilium* L., *Muscari* Mill., *Narcissus* L. Symptoms consist in retarted growth, various mosaics, streaking, spotting, distortion of leaves.

CMV was identified by mechanical sap inoculation of test-plants (Table 1). Electron microscopy investigation of negatively stained preparations from leaves of naturally infected plants and inoculated test-plants revealed isometric particles about 30 nm in diameter. CMV infection in crocus, narcissus was confirmed serologically.

Table. **Test-plant reaction to inoculation of viruses**

Test-plant	CMV	TRV	TRSV	NMV
Amaranthus caudatus			L; S	
A. paniculatus			L; S	
Atriplex hortensis	L	L	L; S	
Chenopodium amaranticolor	L	L	L; S	L
C. quinoa	L	L	L; S	L
Celosia argentea f. cristata			L; S	
Cucumis sativus	L; S	L	L; S	L
Gomphrena globosa	L	L	L; S	L; S
Nicandra physalodes	L; S	L		
Nicotiana glutinosa	S	L	L	
N. rustica	L; S		L	
N. tabacum	S	L	L; S	
Petunia hybrida	L; S		L; S	
Phaseolus vulgaris		L		
Pisum sativum				L
Tetragonia expansa	L		L; S	L
Trifolium incarnatum				S

Abbreviations: L – local reaction, S – systemic reaction.

Hyacinthus mosaic potyvirus (HyaMV) infects hyacinths. Infected plants show mottle mainly on the basal parts of leaves which range colour from light green to bright yellow. The mottle is stripe-like. Virus was not transmitted to test-plants by mechanical sap inoculation. Slight flexuous filamentous particles of normal length (740–750 nm) were detected by electron microscopy. This particle morphology of HyaMV has been reported in literature [6].

Iris mild mosic potyvirus (IMMV) was identified in crocus. Leaves of infected plants are narrowed, twisted, with light greenish, sometimes necrotic spots and streaks. Petals are crinkled and wavy with a colour-breaking pattern. From a range of inoculated test-plants only *Chenopodium quinoa* developed local lesions. Electron microscopy revealed slight flexuous filamentous particles of normal length (750 nm) specific for potyviruses.

Lily mottle potyvirus (LMV) was identified in some lily cultivars. Leaves of naturally infected plants show yellowish green mottle mosaic, can be twisted and narrowed. Flowers of some cultivars are malformed and may show a breaking pattern. The symptoms are intensified when plants are infected also with LSV. When plants become infected shortly after leaf emergence extreme symptoms such as yellowing and browning of leaves and veins may occur in some cultivars. Viral infection was successfully transmitted by mechanical sap inoculation to *C. quinoa* and *Tetragonia expansa,* inducing local reaction. Slight flexuous filamentous particles of normal length (750–770 nm) were detected by electron-microscopy investigation.

Lily symptomless carlavirus (LSV) was identified in lily. Many cultivars remain symptomless when infected with LSV. Leaves may show vein-clearing or light stripes between the veins. Plants often show reduced growth, smaller flowers, have a pronounced lower bulb yield and shorter vase life as cut flowers. When LSV are coinfected with CMV, leaves show grey or brown necrotic spots. Flowers are distorted. LSV was not transmitted to test-plants, but was detected by electron microscopy. Particles were 640–650 nm in length as have been reported in literature [7].

Muscari mosaic potyvirus (MMV) was identified in *Muscari armeniacum* Baker (yellowish green spots and streaks on leaves, in the middle turning to necrosis, leaf narrowing, deformation); *M. botryoides* (L.) Mill. (leaves are distorted, narrowed with light green dots, tip yellowing); *M. pallas* (twisted small leaves with yellowish green striping), *M. tubergenianum* Hook. (light green stripes extending from the basal parts of leaves, leaf distortion). Virus was identified by test-plant inoculation. *Chenopodium murale, C. quinoa* and *Tetragonia expansa* reacted expressing chlorotic local lesions. Flexuous filamentous particles with a normal length of 710 nm were revealed by electron microscopy. Purification of MMV was carried out from frozen *C. quinoa* leaves. Purified MMV preparation had A_{max} at 260 nm, A_{min} at 240 nm, the A_{260}/A_{280} ratio being 1.2. The yield of purified virus was 33 mg from 1 kg of plant tissue.

Narcissus mosaic potexvirus (NMV) was identified in narcissus. The plants showed retarted growth, leaves were narrowed with mild mosaic symptoms. NMV frequently occurs in complexes with other viruses in more severely affected plants. Virus was identified by test-plant inoculation. Symptoms appeared on *C. amaranticolor*, *C. quinoa*, *Pisum sativum, Trifolium incarnatum*, *G. globosa*, *T. expansa.* Electron microscopy revealed filamentous particles about 550 nm long, as has been recorded in the literature [8].

Narcissus yellow stripe potyvirus (NYSV) was identified in narcissus. Infected plants are stunted and have distorted leaves with chlorotic streaks, particularly in their upper parts; often also flowers are broken. Leaf symptoms appear early in the season, soon after leaf emergence. Virus was transmitted by

sap inoculation only to *Tetragonia expansa* which showed local chlorotic lesions 14 days after inoculation. Electron microscopy revealed flexuous filamentous particles 750 nm long. Such a morphology of NYMV particles has been reported in literature [9].

Tobacco rattle tobravirus (TRV) was identified in crocus, hyacinthus, lilies, muscari, narcissus. Leaves of infected crocus develop light yellow brown necrotic oval spots and ringspots. Flowers are smaller than normal, with a colour-breaking pattern. Leaves of infected hyacinths show light green to yellow stripes and spots. These symptoms may turn to brown or grey necrotic stripes later in the season. Flowers are small, misshapen. Necrosis typical of this virus becomes visible on the bulb scales. Leaves of affected lilies are chlorotic and distorted, with necrotic dots. Plant growth is retarted. Affected muscari develop a light green yellowish mosaic which consists of elongate spots and streaks. Plants are stunted. Bulbs have brown pressed spots. Infected narcissus plants are stunted. Leaves are yellow and distorted by necrosis. TRV was identified by test-plant reaction (Table 1) and from the morphology of particles. This virus has tubular particles of two lenghts, 190 and 55–115 nm.

Tomato ringspot nepovirus (ToRSV) was identified in lilies, narcissus. Lilies have distorted leaves with chlorotic spots and streaks. Light green mosaic, chlorotic spots and streaks develop on leaves of affected narcisssus. Later in the season chlorotic lesions turn to necrotic and cause leaf distortion. ToRSV was identified by test-plant reaction (Table) and electron microscopy. Electron microscopy revealed isometric particles 28 nm in diameter.

Tomato spotted wilt tospovirus (TSWV) was identified in lilies. Plants are stunted, leaves distorted with chlorotic and necrotic spots. Tops of severely affected plants are brown. Virus was identified by electron microscopy and using literature data [7, 10]. Isometric irregular particles 85–110 nm in diameter were detected in leaves of naturally infected plants.

A great number of the viruses identified (HyaMV, IMMV, LMV, LSV, MMV, NMV and NYSV) are specific to host-plant and infect a restricted host-plant range. CMV was widespread earlier in many ornamental plants in Lithuania, but now the situation has changed and infection of other viruses such as ToRSV, TSWV occur more frequently than CMV. Mixed viral infections are common in these flowers.

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M. Navalinskienė, M. Samuitienė

VIRUSAI, PAŽEIDŽIANTYS SVOGŪNINES IR GUMBASVOGŪNINES GĖLES

Santrauka

Iš svogūninių ir gumbasvogūninių gėlių išskirta ir identifikuota 11 virusų. Jie identifikuoti augalų-indikatorių ir elektroninės mikroskopijos metodais. CMV identifikuotas krokuose, lelijose, žydrėse, narcizuose, HyaMV – hiacintuose, IMMV – krokuose, LMoV ir LSV – lelijose, MMV – žydrėse, NMV ir NYSV – narcizuose, TRV – krokuose, hiacintuose, lelijose, žydrėse, narcizuose, ToRSV – lelijose, narcizuose, TSWV – lelijose. Aprašyti natūraliai užsikrėtusių augalų simptomai ir nustatyta virusinių dalelių morfologija. Išgrynintas MMV ir paruoštas antigenas.