Occurrence of small fruit viruses in Belarus

Valasevich, N.; Kolbanova, E.
Department of Biotechnology, Institute for Fruit Growing, Kovalev str., 2, Samokhvalovichi, 223013, Belarus

Abstract

Epidemiological control of plant virus diseases is necessary for creation of small fruit nurseries and production of berries with stable high yields. Phytosanitary state of *Rubus idaeus* L. and *Ribes* sp. L. was studied in Belarus. The aim of the research was to determine the most widespread small fruit viruses and to select plants that free from all tested viruses for further propagation in vitro as a basis for Nuclear stock. The following viruses were identified: CMV, ApMV, SLRV, RRV, RBDV, ArMV, TBRV and ToRSV. High level of virus infection for small fruit plantations was shown. The most common viruses for all three crops (raspberry, red and black currant) were RRV, SLRV and ArMV. It was noted that infection level of viruses considerably varied from plant cultivars and crops.

Keywords: viruses, raspberry, black currant, red currant, Belarus.

Introduction

Viruses cause pathological changes in small fruits decreasing plant productivity. More than 20 viruses infect *Rubus* worldwide (Diekmann et al., 1994). A number of nepoviruses and *Raspberry bushy dwarf virus* (RBDV) have been detected in raspberry plantations of many countries: UK (Barbara et al., 2001), USA (Ellis et al., 2005), Czech Republic (Špak, 1995) and others. Nepoviruses occurring in *Rubus* are *Arabis mosaic virus* (ArMV), *Strawberry latent ringspot virus* (SLRV), *Raspberry ringspot virus* (RRV), *Tomato black ring virus* (TBRV), *Tobacco ringspot virus* (TRSV) and *Tomato ringspot virus* (ToRSV). They are transmitted in nature by nematodes of genera *Longidorus* (RRV, TBRV) and *Xiphinema* (ArMV, SLRV, TRSV, ToRSV) and may cause progressive decline in vigour with symptoms ranging from chlorotic mottling, line-pattern, mosaic, vein yellowing to leaf curling (Diekmann et al., 1994). RBDV, genus *Idaeovirus*, is transmitted by infected pollen and causes yellow disease, crumbly and deformed fruit (Jones et al., 1982).

The most common among graft transmissible viruses of black and red currants are RRV, SLRV, TBRV, ArMV and *Cucumber mosaic virus* (CMV). In Great Britain the following viruses was found: RRV, SLRV, ArMV and CMV (Thresh, 1966), in Germany - RRV, SLRV, ArMV, CMV and *Tobacco mosaic virus* (TMV) (Kleinhempel, 1970), in Finland - TBRV and RRV (Bremer, 1983). Injuriousness of these pathogens can be very significant for red and black currant plants. Productivity reduction of red currant by 32 % was noted after an artificial inoculation by RRV (Kleinhempel, 1970). CMV can reduce growth and productivity of black currant plants by 15 %-20 %. ArMV infection may also cause decreasing of productivity and growth (Thresh, 1966). ToRSV may induce lower fruitage and even death of red currant plants (Hildebrand, 1939).

Epidemiological control of plant virus diseases is necessary for creation of small fruit nurseries and production of berries with stable high yields. We studied the phytosanitary state of *Rubus idaeus* L. and *Ribes* sp. L. in Belarus. The aim of the research was to determine the most widespread small fruit viruses and to select plants that free from all tested viruses for further propagation in vitro as a basis for Nuclear stock.

Material and methods

Objects of the research were commercial cultivars of *Rubus idaeus* L. and *Ribes* sp. L. in Belarus. Occurrence of small fruit viruses was studied by DAS-ELISA (commercial kits of Sanofi Diagnostics Pasteur company). Analysis was carried out in spring time (from middle of May till beginning of June). Leaves were source of plant tissue for test. The following viruses were identified: CMV, ApMV, SLRV, RRV, RBDV, ArMV, TBRV and ToRSV according to the “Statute of fruit plant material production in Belarus”. Automatic rider PR2100 with wavelength 405 nm was used for ELISA results recording.

Results

Raspberry viruses: Raspberry plants were mostly infected by the following viruses: 30.5% (of samples) by RBDV, 29.3 % - by RRV, 26.2 % - by ApMV, 21.9 % - by SLRV, 16.7 % - by ArMV. TBRV, ToRSV and CMV were absent in all tested raspberry plants. At the average 41.5 % of samples was free from tested viruses, 25.6 % of samples was infected by only one virus, 21.9 % - by two viruses, 9.7 % - by tree viruses and 1.2 % of samples contained four viruses simultaneously. Interesting that in samples with single virus infection in 61.9 % of cases RBDV was detected. In samples with two viruses more often was found the following combination of viruses: RBDV+RRV (33.3%) and RRV+SLRV (33.3%) (Table 1).

Tab. 1 Occurrence of graft transmissible viruses in raspberry plantation of the Institute for Fruit Growing

	Percent of infection							
Cultivar	**RRV**	**SLRV**	**RBDV**	**ArMV**	**CMV**	**ApMV**	**TBRV**	**ToRSV**
at the average within 6 cultivars	29.3	21.9	30.5	16.7	0	26.2	0	0
'Alyonushka'	22.7	36.4	4.5	28.6	0	71.4	0	0
'Meteor'	52.6	52.6	21	15.8	0	0	0	0
'Balsam'	0	0	76.5	0	0	5.9	0	0

Occurrence of raspberry viruses considerably varied from plant cultivars. Thus 'Alyonushka' plants were infected by ApMV (71.4 %), SLRV (36.4 %), ArMV (28.6 %), RRV (22.7 %) and RBDV (4.5 %). It was noted that 27 % of tested plants contained simultaneously 2 viruses, 18.2 % of infected plants contained either 1 or 3 viruses. 36.4 % of plants had no one from all tested viruses.

'Meteor' plants were infected basically by the same group of viruses but in other proportion: SLRV (52.6 %), RRV (52.6 %), RBDV (21 %) and ArMV (15.8 %). It was determined that 5.3 % of samples contained only one virus, 26.3 % of samples contained two viruses, 21 % contained tree viruses, and 5.3% contained 4 viruses simultaneously. 42.1 % of given variety samples had no one from all tested viruses. Interesting that in samples with complex infection in 90 % of cases SLRV and RRV viruses were found.

'Balsam' plants were heavily infected by RBDV (76.5 % of samples was positive), and only 5.9 % of plants by ApMV. 23.5 % of samples were free from all tested viruses.

Black currant viruses: High level of infection was detected in black currant collection: RRV (100 %), SLRV (100 %), TBRV (97.5 %) and ArMV (81.8 % of tested samples were infected correspondingly) while CMV infected only 5.8 % of samples. TBRV infection rate of black currant cultivars was 100 % with the exception of 'Katyusha' plants (83.3 % of samples were positive). Rate of ArMV infection have considerably varied among tested cultivars. Thus black currant cultivars 'Cerera', 'Buelorusskaya Sladkaya', 'Partisanka', 'Zagadka', 'Seyanec Golubky', 'Orloviya' were infected by 100%, while 'Pamyat Vaviloba' – by 60 %, 'Katyusha' – by 44.4 % (Table 2).

Tab. 2 Occurrence of graft transmissible viruses in black currant collection planting of the Institute for Fruit Growing

	Percent of infection				
Cultivar	**RRV**	**SLRV**	**TBRV**	**ArMV**	**CMV**
'Cerera'	100	100	100	100	100
'Buelorusskaya Sladkaya'	100	100	100	100	54.5
'Partisanka'	100	100	100	100	0
'Zagadka'	100	100	100	100	4.5
'Katyusha'	100	100	83.3	44.4	0
'Pamyat Vavilova'	100	100	100	60	0
'Seyanec Golubky'	100	100	100	100	0
'Kantata'	100	100	100	0	0
'Orloviya'	100	100	100	100	0

Infection level was no less intensive in propagation plantation of black currant: RRV (100 %), TBRV (93.3 %), SLRV (71.1 %), CMV (62.2 %). TBRV was detected in 90 % of 'Pamyat Vavilova' samples, in 80 % of 'Katyusha' samples, and 100 % infection was presented in cultivars 'Klussonovskaya', 'Cerera', 'Zagadka', 'Kupalinka' and 'Naslednica'. SLRV infection rate vary from 40 % to 100 %. All tested cultivars were infected by CMV. It should be noted that the least CMV infection had cultivars 'Kupalinka' and 'Naslednica' (both 20 %) (Table 3).

Tab. 3 Occurrence of graft transmissible viruses in black currant propagation plantation of the Institute for Fruit Growing

	Percent of infection			
Cultivar	**RRV**	**SLRV**	**TBRV**	**CMV**
'Pamyat Vavilova'	100	40	90	40
'Katyusha'	100	70	80	70
'Klussonovskaya'	100	100	100	100
'Cerera'	100	80	100	100
'Zagadka'	100	80	100	100
'Kupalinka'	100	100	100	20
'Naslednica'	100	60	100	20

Red currant viruses: The most widespread red currant viruses were RRV and TBRV (47.9 % and 34 % of infected plants correspondingly). Infection of cultivars by RRV varied from 5 % ('Rondom') to 100 % ('Fertody'). The highest infection rate of TBRV was noted of cultivars 'Krasnaya Andreychenko' (90 % of infected samples) while in all other cultivars it didn't exceed 35 %. CMV was detected in 2.1 %, ArMV – in 4.3 %, SLRV – in 9.6 % and ToRSV – in 10.6 % of checked samples.

CMV occurred only in "Jonkher Van Tets' plants (14.3 % infected plants). Cultivars 'Fertody' and 'Krasnaya Andreychenko' were affected by ArMV (5 % and 15 % infected samples correspondingly). SLRV was found in 10 % of 'Krasnaya Andreychenko' samples, in 15 % of 'Rondom' samples and in 28.6 % of 'Jonkher Van Tets' samples. ToRSV was detected in 'Fertody', 'Nenaglyadnaya' and 'Jonkher Van Tets' (5 %, 25 % and 28.6 % of infected samples correspondingly) (Table 4).

Tab. 4 Occurrence of graft transmissible viruses in red currant propagation plantation of the Institute for Fruit Growing

	Percent of infection					
Cultivar	**RRV**	**SLRV**	**TBRV**	**ArMV**	**CMV**	**ToRSV**
'Rondom'	5	15	35	0	0	0
'Nenaglyadnaya'	40	0	5	0	0	25
'Jonkher Van Tets'	35.7	28.6	14.3	0	14.3	28.6
'Krasnaya Andreychenko'	55	10	90	15	0	0
'Fertody'	100	0	20	5	0	5

Discussion

The results characterise the epidemiological situation for the most common *Rubus* and *Ribes* viruses in Belarus. High level of virus infection for small fruit plantations was shown. The most common viruses for all three crops (raspberry, red and black currant) were RRV, SLRV and ArMV. It was noted that infection level of viruses considerably varied from plant cultivars and crops. For example, in red currant plants percentage of RRV was the lowest in 'Rondom' (5 %) and the highest in 'Fertody' plants (100 %), in red raspberry the level of the infection varied from 0% for 'Balsam' till 52.6 % for 'Meteor' cultivar while all tested black currant plants contained the virus.

In the issue of conducted research free from tested viruses plants were isolated and used for in vitro propagation. In cases when it was impossible to find virus-free plants plant material was used for chemotherapy experiments *in vitro*.

Knowledge of viruses that infect berries, their distribution and ways of control is important for establishing commercial berry plantations and especially nurseries. Thus, virus diagnostics and epidemiological control of plant virus diseases are necessary for creation of virus-free plants and for the monitoring of propagated certificated planting stock. Production of virus tested and virus free planting stock is one of the scientific priorities in development of small fruit growing in Belarus.

This work was a part of the State Program of Fruit Growing Development with the aim to develop and apply in industry a production system of certified plant material for fruit and berry crops in Belarus.

Literature

Bremer, K.; 1983: Viral diseases occurring on Ribes species in Finland. Annales Agriculturae Fenniae **22**, 104-109.

Barbara, D. J.; Morton, A.; Ramcharan, S.; Cole, I. W.; Phillips, A.; Knight, V. H.; 2001: Occurrence and distribution of Raspberry bushy dwarf virus in commercial *Rubus* plantations in England and Wales. Plant Pathology **50**, 747-754.

Diekmann, M.; Frison, E.A.; Putter, T.; (eds.) 1994: FAO/IPGRI Technical Guidelines for the Safe Movement of Small Fruit Germplasm. Food and Agriculture Organization of the United Nations, Rome/International Plant Genetic Resources Institute, Rome.

Ellis, M.A.; Martin, R.R.; Wright, S.R.; 2005: First report of raspberry bushy dwarf virus in Ohio. Plant Health Progress. PHP-2005-0510-01-HN.

Hildebrand, E.M.; 1939: Currant mosaic. Phytopathology. **29**, 369-371.

Jones, A.T.; Murant, A.F.; Jennings, D.L.; Wood, G.A.; 1982: Association of raspberry bushy dwarf virus with raspberry yellows disease; reaction of *Rubus* species and cultivars, and the inheritance of resistance. Annals of Applied Biology **100**: 135-147.

Kleinhempel, H.; 1970: Verbreitung und Schadwirkung von virosen an Johannis und Stachelbeere. Arch. Garten. **18**, 319-325.

Kleinhempel, H.; 1970: Zur Nachweissicherheit mechanisch ubertragbarer viren bei der Testung von Johannisbeermutterpflanzen. Arch. Garten. **18**, 267-272.

Špak, J.; 1995: The occurence of nepoviruses on raspberries and blackberries in the Czech Republic. Acta Horticulturae 385, 117-121.

Thresh, J.M.; 1966: Virus diseases of black currant. Ann. Rep. East Malling Research Station for 1965. 158-163.