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# Distribution of viruses in the shallot germplasm collection of the Czech Republic – Short Communication

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**Abstract**

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The Czech collection of shallot (*Allium cepa* var. *ascalonicum*) genetic resources (122 accessions) was surveyed for the presence of four different viruses, i.e. *Onion yellow dwarf virus, Leek yellow stripe virus, Garlic common latent virus* (GCLV), and *Shallot latent virus*, by DAS-ELISA. The shallot seems to be resistant against GCLV because none of the tested plants was infested by this virus. Other three viruses were found with an incidence ranging from 53% to 93% for genotypes and 48% to 87% for plants. Most of the tested shallot genotypes were simultaneously infected with two or three viruses. These results were compared with neighbouring collection of garlic where all four viruses were found widespread with an incidence ranging from 65% to 83% for genotypes and 39% to 61% for plants.

**Keywords**: *Allium cepa* var. *ascalonicum*; ELISA; OYDV; LYSV; GCLV; SLV

On a global scale, shallot (*Allium cepa* var. *ascalonicum* L.) is a minor alliaceous crop, but in the areas (South-East Asia, Africa), where onion seed is hard to produce and/or the growing season is too short for the production of bulb onion, the vegetatively propagated shallot is cultivated as an important substitute for bulb onion. Shallot is also preferred to bulb onions by some consumers for their good culinary qualities, such as high pungency and unique flavour. The majority of shallot genotypes are clonally propagated, even where seed production is possible, to maintain the unique quality traits and population homogeneity of the highly heterozygous plants. Vegetative propagation, however, suffers from some major disadvantages and one of them is non-attendance of "cleaning" sexual cycle to eliminate viruses from the vegetative issues (Rabinowitch, Kamenetsky 2002).

Viruses are a particular problem in *Allium* crops such as garlic and shallot, since vegetative propagation leads to the accumulation and dissemination of viruses in planting material (Ward et al. 2009). Viruses infecting *Allium* have been widely studied and found widespread throughout the world. Also the frequent occurrence of mixed virus infections in garlic and onion crops, often referred to as a "garlic viral complex", has been mentioned (Walkey et al. 1987; Fletcher, Fletcher 1989; van Dijk 1993; Dovas et al. 2001; Takaichi et al. 2001; Chen et al. 2002; Mahmoud et al. 2008). Viruses of *Allium* spp. cause yield loss and deterioration in the quality of the crop (Walkey, Antill 1989; Lot et al. 1998; Conci et al. 2002, 2003; Cafrune et al. 2006; Lunello et al. 2007). However, the virus infection does not cause problems only in

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commercially grown *Allium* crops, but also in the collections of genetic resources of these crops, carried as field collections in Europe (Keller, Senula 2001) and probably around the world because the geographical distribution of some garlic viruses is cosmopolitan (Diekmann 1997).

Despite the fact that the typical symptoms of infection – yellow spots on the leaves – nearly was not observed in the Czech germplasm collection of shallot genetic resources, the sanitary status of collection (122 accessions) was studied and compared with the previous result of sanitary status of garlic collection (Smékalová et al. 2010) which is cultivated next by the shallots for many years.

## MATERIAL AND METHODS

Shallot collection is composed of 122 accessions and each accession is presented by 19 plants in Olomouc. The origin of tested genotypes is mostly European (4 AUT, 6 CSK, 22 CZE, 7 DEU, 33 FIN, 4 FRA, 1 GBR, 1 HUN, 2 NLD, 16 NOR, 1 POL, 1 ROM, 11 SUN and 1 SVK = 110 genotypes in total) but also a few genotypes from other continents were presented (1 CHN, 1 IND, 1 USA, 9 IDN). The accessions in the collection represent a wide scale of genotypes including traditional varieties and/or landraces from different countries and continents.

Five random plants of each accession were individually analysed for virus occurrence. Samples of symptomatic and asymptomatic shallot leaves were tested serologically in March and April. Commercial antibodies (Bioreba, Reinach, Switzerland) were used for virus detection by DAS-ELISA. Samples were prepared by grinding 0.5 g of fresh leaves in phosphate-buffered saline, pH 7.4 with 2% polyvinylpyrrolidone and 0.2% of egg albumin in the ratio 1:10 (wt.:vol). Reactions were read with EL×800 Absorbance Microplate Reader (BIO-TEK, Winooski, USA) at 405 nm after 1 h incubation of the substrate at room temperature. Based on the analysis of negative control samples (Bioreba, Reinach, Switzerland) the threshold for determining the infectious status of the plant samples was set and only samples with $A_{405} > 0.10$ were considered as positive. All accessions were tested for the presence of *Onion yellow dwarf virus* (OYDV, potyvirus), *Leek yellow stripe virus* (LYSV, potyvirus), *Garlic common latent virus* (GCLV, carlavirus) and *Shallot latent virus* (SLV, carlavirus).

## RESULTS AND DISCUSSION

As shown in Table 1, 120 of 122 shallot accessions (ca. 98.4%) were infected by at least one virus in at least one of the 5 plants. Single virus infections (at least one positive plant from 5 plants tested) were detected in 32 accessions, double infections in 44 and triple infections also in 44 accessions. The occurrence of GCLV was not detected in any of the tested shallot plants.

SLV was the most widespread virus in the shallot collection, as they occurred in 93.4% of the accessions, although the other two viruses (OYDV and LYSV) occurred often (53.2% resp. 59.9%) as well (Table 2).

Also the relative combinations of the tested viruses in case of multiple infections were studied in the shallot samples (Table 3). Double infection with LYSV and SLV was the most frequent virus combination although OYDV and SLV combined infection occurred also at a similar rate (18.9 resp. 15.6%). Triple virus infection occurred at a rate of 36.1%. These results fully correspond to the claim of Alves-Jùnior et al. (2008) about the "garlic viral complex", which is a disease usually induced by simultaneous infections of several viruses belonging to Potyvirus (OYDV, LYSV and WYDV), Carlavirus (GCLV, GLV), and Allexivirus (GarV-A, GarV-B, GarV-C, GarV-D, GarMbFV) families of plant viruses.

Compare to the garlic collection sanitary status of shallot grown in the Czech germplasm collection (Smékalová et al. 2010) seems to be better. It is mainly thanks to the surprising non-occurrence of GCLV in the shallots, but also occurrence of other studied virus diseases except the SLV lower in shallots in comparison to the garlic (Table 4).

GCLV has a wide host range within the Alliace family. It predominantly occurs in garlic (van Dijk 1993), but has been found in more than 50 *Allium* sp. in a germplasm collection (Graichen, pers. comm. in Diekmann 1997). No mention of GCLV

Table 1. Sanitary status of the Czech shallot genetic resources collection

| Status | | No. of genotypes | Genotypes share (%) |
|---|---|---|---|
| All 5 plants are healthy | | 2 | 1.6 |
| At least 1 plant is infected by: | 1 virus | 32 | 26.2 |
| | 2 viruses | 44 | 36.1 |
| | 3 viruses | 44 | 36.1 |
| Σ | | 122 | 100 |

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Table 2. Incidence of viruses in the Czech shallot genetic resources collection

| Virus | OYDV | | LYSV | | GCLV | | SLV | |
|---|---|---|---|---|---|---|---|---|
| No. of infected plants | No. of genotypes | (%) | No. of genotypes | (%) | No. of genotypes | (%) | No. of genotypes | (%) |
| 0 | 57 | 46.7 | 49 | 40.2 | 122 | 100 | 8 | 6.6 |
| 1–4 | 7 | 5.7 | 34 | 27.9 | 0 | 0 | 16 | 13.1 |
| 5 | 58 | 47.5 | 39 | 32.0 | 0 | 0 | 98 | 80.3 |
| Σ 1–5 | 65 | 53.2 | 73 | 59.9 | 0 | 0 | 114 | 93.4 |

OYDV – *Onion yellow dwarf virus*; LYSV – *Leek yellow stripe virus*; GCLV – *Garlic common latent virus*; SLV – *Shallot latent virus*; 0: All five tested plants were negative for virus incidence; 1–4: One to four of five tested plants were positive for virus incidence; 5: All five tested plants were positive for virus incidence; Σ 1–5: At least one of five or all the five tested plants were positive for virus incidence; % of genotypes were counted from the total set of 122 genotypes

Table 3. Double infection and relative combinations of shallot viruses (counted from the total set of 122 genotypes)

| Double virus infection | No. of genotypes | Genotypes share (%) |
|---|---|---|
| OYDV + LYSV | 2 | 1.6 |
| OYDV + SLV | 19 | 15.6 |
| LYSV + SLV | 23 | 18.9 |

for abbreviations see Table 2

Table 4. Comparison of virus diseases occurrence in the garlic and shallot Czech germplasm collection (share of genotypes with at least one positive plant (%))

| Germplasm collection/virus | OYDV | LYSV | GCLV | SLV |
|---|---|---|---|---|
| Garlic | 79.6 | 65.3 | 82.3 | 82.6 |
| Shallot | 53.2 | 59.9 | 0 | 93.4 |

for abbreviations see Table 2

presence in shallot, however, has not been published, yet.

## References


Alves-Jùnior M., Marraccini F.M., de Albuquerque Melo Filho P., Dusii A.N., Pio-Ribeiro G., Ribeiro B.M. (2008): Recombinant expression of Garlic virus C (GARV-C) capsid protein in insect cells and its potential for the production of specific antibodies. Microbiological Research, 163: 354–361.

Cafrune E.E., Perotto M.C., Conci V.C. (2006): Effect of two *Allexivirus* isolates on garlic yield. Plant Disease, 90: 898–904.

Chen J., Chen J.P., Adams M.J. (2002): Characterisation of some carla- and potyviruses from bulb crops in China. Archives of Virology, 147: 419–428.

Conci V.C., Lunello P., Buraschi D. (2002): Variations of Leek yellow stripe virus concentration in garlic and its incidence in Argentina. Plant Disease, 86: 1085–1088.

Conci V.C., Canavelli A., Lunello P., Di Rienzo J., Nome S.F., Zumelzu G., Italia R. (2003): Yield losses associated with virus-infected garlic plants during five successive years. Plant Disease, 87: 1411–1415.

Diekmann M. (1997): *Allium* spp. FAO/IPGRI Technical Guidelines for the Safe Movement of Germplasm No. 18.

Dovas C.I., Hatziloukas E., Solomon R., Barg E., Shiboleth Y., Katis N. (2001): Incidence of viruses infecting *Allium* spp. in Greece. European Journal of Plant Pathology, 107: 677–684.

Fletcher P.J., Fletcher J.D. (1998): *In vitro* elimination of onion yellow dwarf and shallot latent viruses in shallots (*Allium cepa* var. *ascalonicum* L.). New Zealand Journal of Crop and Horticultural Science, 26: 23–26.

Keller E.R.J., Senula A. (2001): Progress in structuring and maintaining the garlic (*Allium sativum*) diversity for the European GenRes project. Acta Horticulturae (ISHS), 555: 189–193.

Lot H., Chovelon V., Souche S., Delecolle B. (1998): Effects of Onion yellow dwarf and Leek yellow stripe viruses on symptomatology and yield loss of three French garlic cultivars. Plant Disease, 82: 1381–1385.

Lunello P., Di Rienzo J., Conci V.C. (2007): Yield loss in garlic caused by *Leek yellow stripe virus* Argentinean isolate. Plant Disease, 91: 153–158.

Mahmoud S.Y.M., Abo-El Maaty S.A., El-Borollosy A.M., Abdel-Ghaffar M.H. (2008): Identification of *Onion yellow dwarf potyvirus* as One of the Major Viruses Infecting Garlic in Egypt. International Journal of Virology, 4: 1–13.

Rabinowitch H.D., Kamenetsky R. (2002): Shallot (*Allium cepa*, Aggregatum Group). In: Rabinowitch H.D., Currah L.

doi: 10.17221/271/2015-HORTSCI

(eds.): Allium crop science: recent advances. Wallingford, CABI Publishing.

Smékalová K., Stavělíková H., Dušek K. (2010): Distribution of viruses in the garlic germplasm collection of the Czech Republic. Journal of Plant Pathology, 96: 273–274.

Takaichi M., Nagakubo T., Oeda K. (2001): Mixed virus infections of garlic determined by a multivalent polyclonal antiserum and virus effects on disease symptoms. Plant Disease, 85: 71–75.

van Dijk P. (1993): Survey and characterization of potyviruses and their strains of Allium species. Netherlands Journal of Plant Pathology, 99 (2 Supplement): 1–48.

Walkey D.G.A., Antill D.N. (1989): Agronomic evaluation of virus-free and virus-infected garlic (*Allium sativum* L.). Journal of Horticultural Science 64: 53–60.

Walkey D.G.A., Webb M.J.W., Bolland C.J., Miller A. (1987): Production of virus-free garlic (*Allium sativum* L.) and shallot (*A. ascalonicum* L.) by meristem-tip culture. Journal of Horticultural Science, 62: 211–220.

Ward L.I., Perez-Egusquiza Z., Fletcher J.D., Clover G.R.G. (2009): A survey of viral diseases of Allium crops in New Zealand. Australian Plant Pathology, 38: 533–539.

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