

UDC 632.913.1

## **GRAPEVINE RODITIS LEAF DISCOLORATION-ASSOCIATED VIRUS: EXPRESS PEST RISK ANALYSIS FOR UKRAINE**

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Received February 22, 2022 / Received March 25, 2022 / Accepted April 19, 2022

**Aim.** To conduct an express pest risk analysis of *Grapevine Roditis leaf discoloration-associated virus* (GRLDaV) for Ukraine, a virus that has been related to a grapevine disease and was included in the EPPO Alert List in 2018. **Methods.** The phytosanitary risk analysis was carried out on the basis of an analytical review of expert literature and in accordance with the EPPO Decision-support scheme for an Express Pest Risk Analysis (EPPO, 2012) and with methodological recommendations for Ukraine (Pylypenko et al, 2012). The possibility of further spread and the potential range of the virus were determined using modern software packages AgroAtlas (Afonin and Li, 2011; Shumilin and Li, 2009), MapInfo Pro15.0 (ESTIMap®) and IDRISI SELVA (Clarklabs®). **Results.** An express pest risk analysis of GRLDaV for Ukraine was carried out for the first time. Outbreaks of the virus were first detected in the 1980ies in Greece (Rumbos, Avgelis, 1989) and from 2014–2018 in: Italy (Chiumenti et al, 2015, 2016; Maliogka et al, 2015), Turkey (Adan, 2016; Serçe et al, 2018) and Croatia (Vončina et al, 2018). Climatic predictors were analyzed in the outbreaks of the countries where the causal agent of the disease was identified. The potential range of GRLDaV in Ukraine has been established in case of importing infected planting material with further spreading of the virus. Risk management measures are proposed, which envisage including GRLDaV in the list of the Regulated Non-Quarantine Harmful Organisms of Ukraine. **Conclusions.** There is a possibility of introduction, further spread, and harmfulness of *Grapevine Roditis leaf discoloration-associated virus* in Ukraine, which is due to the presence of the host plant (grapevine, *Vitis vinifera* ssp. *vinifera* L.) and the corresponding climatic conditions of the southern and (part of) western Ukraine, where grapevine is cultivated on an industrial scale. The introduction of GRLDaV into Ukraine is possible as a result of the import of GRLDaV-infected grapevine planting material from the countries where the virus has been reported and presumably is still present. The current Ukrainian phytosanitary measures cannot reliably prevent the risk of introduction of GRLDaV into Ukraine. The inclusion of GRLDaV in the List of the Regulated Non-Quarantine Harmful Organisms of Ukraine with the recommendation of permission to import grapevine planting material certified for the absence of GRLDaV (from the countries where the virus is reported) or mandatory testing of imported grapevine planting material for the presence of GRLDaV (from areas where such certification is absent), can be an effective risk management measure. It requires the producers and importers of grapevine planting material to include GRLDaV virus in their certification schemes to prevent eventual further spreading of the virus. It is recommended to do a nation-wide survey to determine the likelihood of the presence of GRLDaV in the region. Further research to identify possible natural virus vectors and to develop methods of (latent) GRLDaV diagnostics are needed. Finally additional studies on prevention and control of the virus (including breeding for resistance) are also required.

**Key words:** GRLDaV, *Vitis vinifera*, geographical distribution.

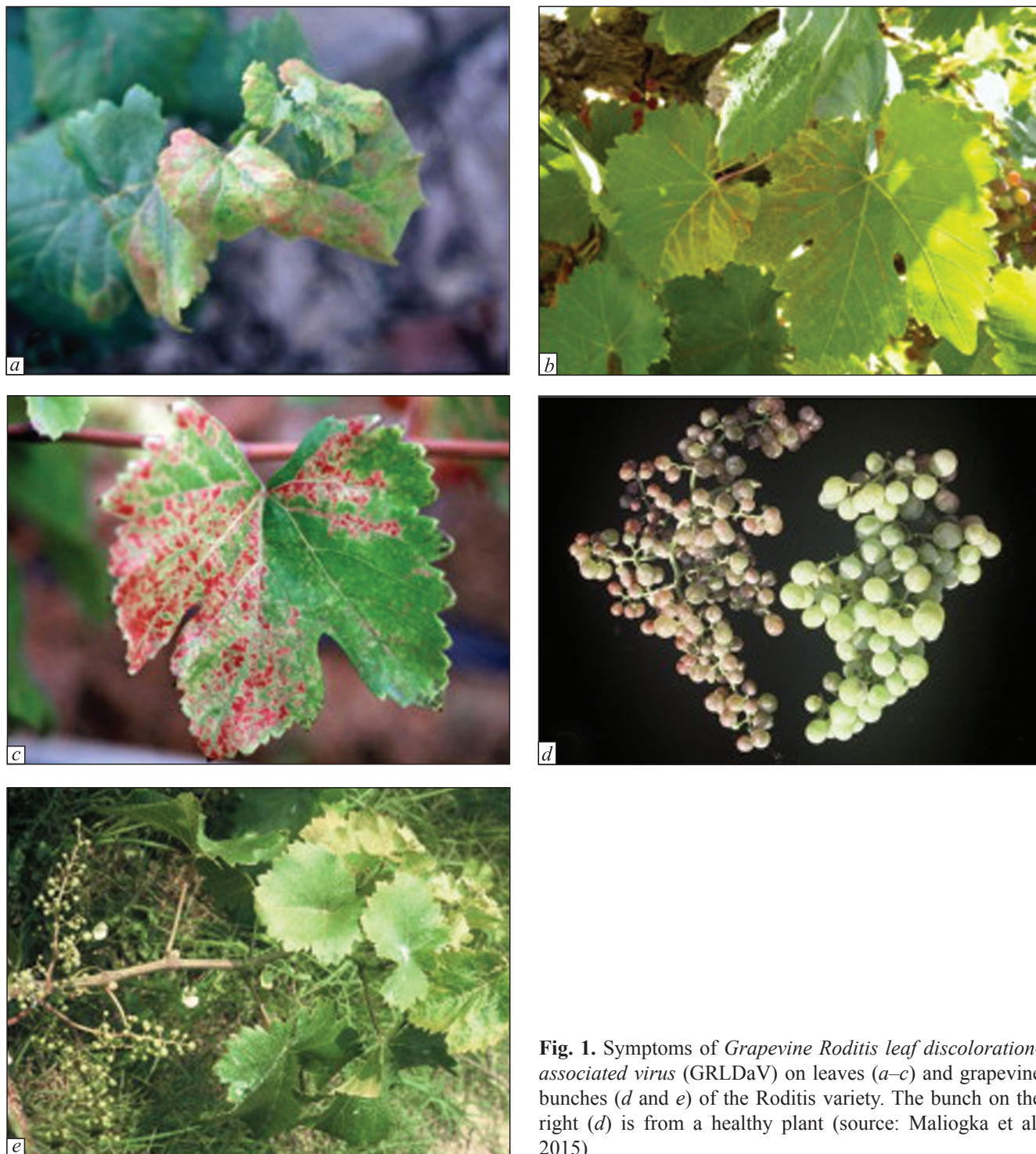
**DOI:** <https://doi.org/10.15407/agrisp9.01.039>

### **INTRODUCTION**

*Grapevine Roditis leaf discoloration-associated virus* (GRLDaV) has been related to a disease of grape-

vine, characterized by symptoms, which appeared at the end of summer by discoloration in different parts of leaf blade tissues. It was first described in the 1980s

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**Fig. 1.** Symptoms of *Grapevine Roditis leaf discoloration-associated virus* (GRLDaV) on leaves (a–c) and grapevine bunches (d and e) of the Roditis variety. The bunch on the right (d) is from a healthy plant (source: Maliogka et al, 2015)

in Greece, in vineyards of the Almyros province, on four-year-old grapevine plants (*Vitis vinifera*, variety *Roditis*, grafted on rootstock 110R) (Rumbos, Avgelis, 1989; EPPO Alert List, 2018). In more detail symptoms of GRLDaV are yellow or reddish spots on the leaves often along the leaf veins, or between the veins. These changes in the coloration may be rather

evenly distributed along the leaf blade or be present only on some parts of the leaf. The discolored parts have uneven surfaces and sizes; there is an abnormal number of veins, deformation, and upward leaf rolling. The bunches diminish in size and number; the grapes do not develop their color, remain green and immature, and have low sugar content (Rumbos,



**Fig. 2.** Countries, where *Grapevine Roditis leaf discoloration-associated virus* has been locally reported (<https://www.cabi.org/isc/datasheet/11285332#toDistributionMaps>)

Avgelis, 1989; Martelli, Saldarelli, 2015; Maliogka et al, 2015) (Fig. 1).

The etiology of this disease remained unclear for a long time. Only in 2015, when next generation sequencing (NGS) technology was applied to samples, obtained from a twenty-year-old grapevine plant of cv. Roditis with typical disease symptoms, an unknown DNA-virus was found (apart from some known viruses and viroids of grapevine) (Maliogka et al, 2015). A phylogenetic analysis classified this newly detected virus as one belonging to the genus *Badnavirus*, with closest relationship to *Fig badnavirus* 1 (FBV-1). Further studies by the same group of scientists showed that this new *Badnavirus* species is closely related with the Roditis leaf discoloration (RLD) disease and the provisional name *Grapevine Roditis leaf discoloration-associated virus* (GRLDaV) was proposed.

To detect GRLDaV, a sensitive and specific quantitative real-time PCR TaqMan was developed (Morán et al, 2020). This real-time PCR detected all known GRLDaV isolates, regardless of their high degree of genetic diversity, from different geographic locations. In addition, it was successfully used for the quantitative determination of GRLDaV in the vegetative material and in two (artificially contaminated) species of mealybugs – *Planococcus citri* and *Pseudococcus viburni*,

which transmitted the virus under experimental conditions (Morán et al, 2020). The virus can be artificially transmitted to *V. vinifera* as well as to herbaceous plants *Chenopodium quinoa*, *Gomphrena globosa*, and *Nicotiana benthamiana* (EPPO Alert List, 2018). In 2015, GRLDaV was determined in symptomless grapevine material and additional primers for classical and Real-Time PCR were developed (Doganer, 2019).

In 2014 and 2015, the presence of GRLDaV was confirmed in some local grapevine cultivars (Bombino nero, Pinot Gri) in Italy, in the provinces of Apulia and Trentino (Chiumenti et al, 2015, 2016; Maliogka et al, 2015). In 2016, the disease was first found in vineyards of Adan in Turkey (Serçe et al, 2018). In 2018, GRLDaV was found in some grapevine accessions in Croatia (EPPO Alert List, 2018; Vončina et al, 2018).

Summarizing: At present, some isolations of *Grapevine roditis leaf discoloration-associated virus* have been reported from four European countries: Greece, Italy, Turkey, and Croatia (CABI Invasive Species Compendium, 2021) (Fig. 2).

Due to the detection of GRLDaV in the above mentioned countries of the European Union and based on a postulated potentially high harmfulness of the virus in the region, the virus was added to the Alert List

of the European and Mediterranean Plant Protection Organization (EPPO) (EPPO Alert List, 2018). For EPPO members (including Ukraine), that cultivate grapevine, it is a reason to analyze the phytosanitary risk for its territory and grapevine production. This was the aim of the present study, which is an Express Pest Risk Analysis, which was conducted for Ukraine for the first time.

## MATERIALS AND METHODS

The phytosanitary risk was determined in compliance with the EPPO Decision-support scheme for an Express Pest Risk Analysis (EPPO, 2012) and with methodological recommendations for Ukraine (Pylypenko et al, 2012).

The information collection and subsequent analysis of the data about *Grapevine Roditis leaf discoloration-associated virus* were conducted based on the official data of the phytosanitary services of the EPPO member-states (EPPO Reporting Service: [https://www.eppo.int/RESOURCES/eppo\\_publications/eppo\\_reporting\\_service](https://www.eppo.int/RESOURCES/eppo_publications/eppo_reporting_service)), the data of the State Statistics Service of Ukraine, the State Service of Ukraine on Food Safety and Consumer Protection, our own previous studies and international scientific publications.

The possibility for further spread of *Grapevine Roditis leaf discoloration-associated virus* in Ukraine was determined using the software packages AgroAtlas (Shumilin, Li, 2009), MapInfo Pro15.0 (ESTIMap®) and IDRISI SELVA (Clarklabs®). These packages enabled to determine the suitability of Ukraine's climatic conditions for the occurrence and further spread of GRLDaV. These packages were used successfully before for other viruses and climatic conditions in Ukraine (Afonin et al, 2011; Titova, Klechkovsky, 2014; Borzykh et al, 2018; Klechkovsky et al, 2016; Klechkovsky et al, 2018). A preliminary search was conducted with the aim to determine:

climatic factors in the areas where GRLDaV was detected before in Greece, Italy, Turkey, and Croatia (the temperatures of the hottest and coldest months; the Hydrothermal index (HTI));

quantitative amplitude of each limiting factor (the temperatures of the hottest and coldest months; (HTI)) in the GRLDaV detection zones.

Our analysis determined and mapped grapevine producing areas in Ukraine, that are potentially favorable for the introduction, further spread, and harmfulness of GRLDaV.

The conclusions of the phytosanitary risk analysis were formulated according to the EPPO Decision-support scheme for an Express Pest Risk Analysis (EPPO, 2012), EPPO Standard PM 5/3(5) (2011) and methodological recommendations for Ukraine (Pylypenko et al, 2012).

## RESULTS

*Stage I. Initiation. 1. The name of the harmful organism, taxonomic position.*

Domain: Virus

Realm: Riboviria

Order: Ortervirales

Family: Caulimoviridae (dsDNA viruses)

Genus: Badnavirus

Species: Grapevine Roditis leaf discoloration-associated virus (GRLDaV)

*2. What are the reasons for conducting the phytosanitary risk analysis (PRA)?* The reason to conduct PRA for Ukraine was the inclusion of *Grapevine Roditis leaf discoloration-associated virus* (GRLDaV) in 2018 into the Alert List of European and Mediterranean Plant Protection Organization (EPPO) as a virus, first detected and identified in four European countries and probably posing a potential phytosanitary risk for the EPPO region (EPPO Alert List, 2018).

*3. For which zone is PRA conducted?* Ukraine

*Stage II. Evaluation of the phytosanitary risk*

*1. Is the harmful organism present in the PRA zone?* Not known to be present.

*2. What is the status of a harmful organism according to the Directive of EU Council 2000/29?*

EU Lists (Annex I, part A, sections...)	Yes/No
Section I. Harmful organisms not known to occur in any part of the community and relevant for the entire community	No
Section II. Harmful organisms known to occur in the community and relevant for the entire community	No
<i>3. What is the status of the harmful organism in the EPPO?</i>	
EPPO list	Yes/No
List A1 (pests absent from the EPPO region)	No
List A2 (pests are locally present in the EPPO region)	No
The Alert List	Yes, since 2018

4. *What are the host plants of the harmful organism?* Grapevine (*Vitis vinifera* ssp. *vinifera* L.) is the only known host plant for *Grapevine Roditis leaf discoloration-associated virus* (EPPO Alert List, 2018).

5. *Which host plants have economic and (or) ecological significance in the PRA zone?* Grapevine (*V. vinifera*) has great economic significance in Ukraine; both table and wine varieties are cultivated, though the recent rate of using the potential of table grape and wine production has been rather low, first of all, due to the absence of the state support in regulating the normative and regulatory relations in this sphere, in protecting from the pressure due to cheap and not always high quality imported wine and grape juice concentrate for winemaking, and in not providing the relevant financial support for business, especially in its initial stage of development (Avercheva, 2021).

6. *Does a harmful organism need a vector; is there a vector in the PRA zone?* It has been postulated that a vector (probably *Planococcus citri* and/or *Pseudococcus viburni*) may be involved in transmitting the virus under the field conditions. From 1988 to 1992, natural spreading of GRLDaV was observed in Greece (Rumbos, Avgelis, 1989). However, this issue requires further studies. *Planococcus citri* (citrus mealybug) is widespread in Ukraine, on the southern coast of Crimea (CABI Invasive Species Compendium, 2021).

7. *What is the current areal of the harmful organism (distribution in the countries across the continents)?* Europe: reported locally in Greece (Rumbos, Avgelis, 1989), Italy (Chiumenti et al, 2015, 2016; Maliogka et al, 2015), Turkey (Serçe et al, 2018) and Croatia (Vončina D et al, 2018).

8. *The probability of the harmful organism penetration into the PRA zone?*

Improbable  Highly improbable   
 Moderately probable  Probable   
 Highly probable

The highest risk is the international trade in planting material (Steffek et al, 2007). The main way of GRLDaV distribution may be the infected grapevine planting material from the countries where the disease was reported. Previous studies conducted in Greece demonstrated that the virus can be (artificially) mechanically transmitted to the grapevine (for example, *V. vinifera* cv. *Mission*) as well as to *Chenopodium quinoa*, *Gomphrena globosa*, and *Nicotiana benthamiana*. The natural distribution of the disease from 1988 to 1992 in three different vineyards indicated possible infection via grafting (Rumbos, Avgelis, 1989).

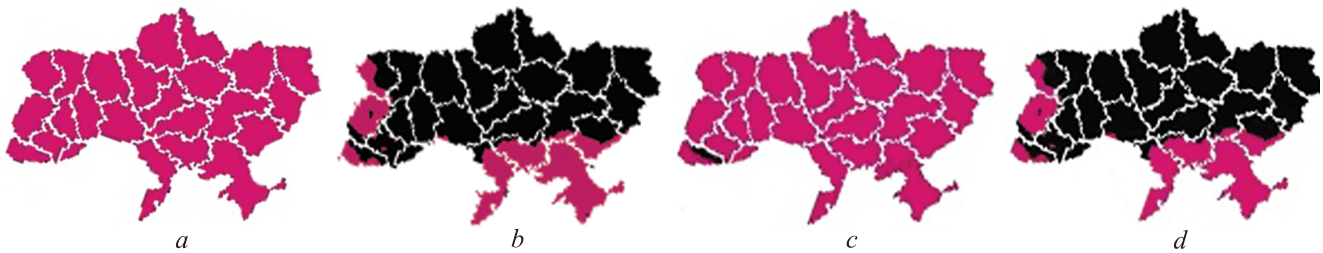
9. *The possibility of the acclimatization of the harmful organism in the environment of the PRA zone?*

Improbable  Highly improbable   
 Moderately probable  Probable   
 Highly probable

According to the Köppen-Geiger climate classification, the climate in the territories of GRLDaV detection up till now belongs to the moderate climate Cfb – with wet and warm summer (Croatia) and Csa – with dry and hot summer (Greece, Italy, Turkey) (Kottek et al, 2006). The Csa climate variant is also typical for the south and southeast of Ukraine, where industrial vineyards are located. The rest of Ukraine’s territory is notable for its wet continental climate with warm sum-

**The amplitudes of climatic indices in the GRLDaV distribution area**

Country	Temperatures of the hottest month, T °C	Temperatures of the coldest month, T °C	Hydrothermal index (HTI)
Greece (Almyras)	23.0; 23.5; <b>22.9</b> ; 23.4; <b>24.5</b> ; 24.2; 23.2	4.1; <b>2.6</b> ; 3.8; 6.5; 7.2; 6.5; <b>8.2</b>	1.36; <b>1.57</b> ; <b>0.33</b> ; 1.35; 0.35
Italy (Trentino, Apulia)	20.3; 20.9; <b>21.0</b> ; 20.3; 20.8; 20.4; <b>17.6</b>	<b>4.6</b> ; 8.2; 11.6; 7.3; <b>9.4</b> ; 6.5; 7.2	1.55; 1.48; 1.76; <b>1.83</b> ; <b>0.95</b>
Turkey (Adan)	<b>25.9</b> ; 22.9; 19.3; 24.6; 17.8; 21.0; <b>16.1</b>	<b>7.7</b> ; -0.8; 4.0; 1.2; 7.3; 0.9; <b>-3.5</b>	0.22; <b>0.14</b> ; 0.24; 0.63; <b>0.91</b>
Croatia (Slavonia)	<b>18.3</b> ; 21.4; 21.3; 19.6; 18.5; 20.0; <b>21.4</b>	-0.3; -0.2; <b>0.2</b> ; -0.3; <b>-2.8</b> ; -0.9; -1.4	<b>1.11</b> ; 1.97; 2.22; <b>2.13</b> ; 1.27



**Fig. 3.** Regions in Ukraine that could meet conditions for establishment of GRLDaV according to: *a* – average temperature of the hottest month (July), *b* – average temperature of the coldest month (January), *c* – HTI, *d* – summarized potential areal

mer (Dfa). In this part of Ukraine, industrial vineyards are located in the Transcarpathian region, but (Table) grapes are cultivated all over the region. Building a digital vector map of the potential areal of the virus, conducted using the software AgroAtlas, MapInfo Pro 15. 00, and IDRISI SELVA, presents the suitability of Ukraine’s climate graphically. The indices of the average monthly temperature of the hottest month and the coldest month, and the hydrothermal index (HTI) were used as predictors of climatic conditions (Table). The maximum and minimum values (marked bold) of the ecological amplitudes in the zones of possible GRLDaV detection were used to determine the suitable territories in terms of each limiting factor of the species distribution on Ukraine’s climatic map.

The territories, suitable in terms of each analyzed climatic factor and potential areal are in a lighter color (pink) in the maps shown in Figure 3. It was demonstrated that in terms of the index of the average monthly temperature of the hottest month, the entire territory of Ukraine corresponds to the conditions of possible GRLDaV detection zones (Fig. 3, *a*). In terms of the average monthly temperature of the coldest month, the conditions are met by the Odesa, Mykolayiv, Kherson regions, the south of the Zaporizhzhia region, an insignificant part of the south in the Dnipropetrivsk region, Crimea as well as Transcarpathian and Lviv regions and the west of the Volyn region. The climate of the remaining part of Ukraine does not correspond to the temperature indices of the GRLDaV detection zones (Fig. 3, *b*). In terms of HTI index, only the high Carpathian Mountains do not meet the indices for possible GRLDaV occurrence (Fig. 3, *c*). The climatically suitable regions are summarized in Fig. 3, *d*.

10. How fast can the harmful organisms spread in the PRA zone?

Very slowly  Slowly   
 Moderately quickly  Quickly   
 Very quickly

GRLDaV could possibly spread moderately quickly due to international and national trade in (infected) planting material. The virus can possibly also spread locally via different mechanical agrotechnical measures in vineyards, such as grafting.

11. Which economic consequences or consequences for the environment can the harmful organism have if official control is not introduced?

Minimal  Insignificant   
 Moderate  Significant   
 Very significant

Badnaviruses affect a wide range of relevant crops and the losses may amount to 10–90 % (Bhat et al, 2016), but losses for GRLDaV so far are not known.

12. Can the harmful organism be a vector for other pathogenic plants?

Very highly improbable   
 Highly improbable   
 Moderately probable  Probable   
 Highly probable

13. What is the possibility of outbreak elimination?

Very highly improbable   
 Highly improbable   
 Moderately probable  Probable   
 Highly probable

Possibly infected planting material can be heat-treated or the virus can be eliminated by meristem-culture (EPPO Standard PM 4/8(2), 2008). The most promising, economically profitable, ecologically safe measure of controlling viral infections could be the use of grapevine cultivars with genetic resistance to the agent. However, there are no data about the resistant cultivars for GRLDaV. Current Ukrainian phytosanitary measures cannot ensure prevention of the import of GRLDaV-infected planting material

GRAPEVINE RODITIS LEAF DISCOLORATION-ASSOCIATED VIRUS

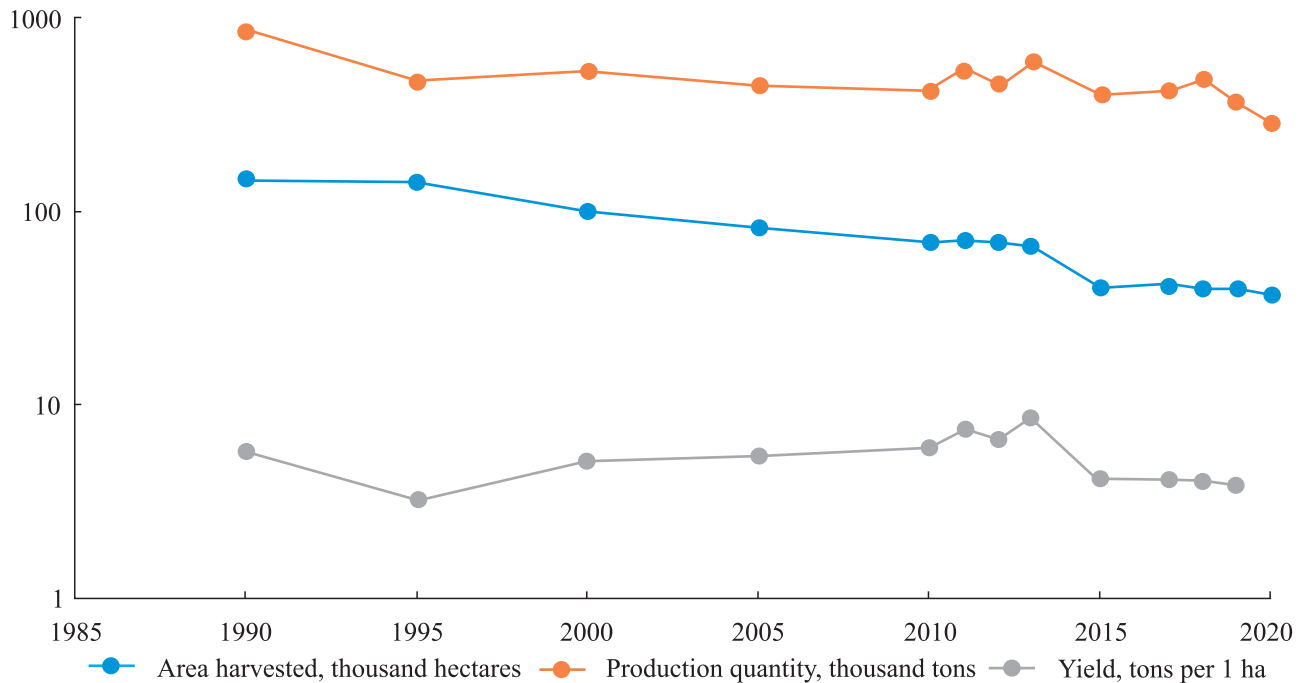


Fig. 4. Area harvested, production quantity and yield of grapevine in Ukraine in 1990–2020

of grapevine. Visual examination cannot guarantee to find the infected planting material (Chiumenti et al, 2015; Maliogka et al, 2015). Certification of the planting material for virus diseases is widely applied, including in Ukraine (EPPO Standard PM 4/8(2), 2008), but internationally does not include GRLDaV to our knowledge. In addition, new species and strains of viruses are regularly detected and described, which may present economic limitations for viticulture (Gadzalo et al, 2015). The absence in Ukraine of a targeted program for detecting latent viral infections during the import of vine planting material results in the insufficiency of information about the risks of their distribution. The producers and importers of grapevine planting material should include GRLDaV virus in their certification schemes to prevent the further spreading of the virus (EPPO Alert List, 2018).

Stage III. Evaluation of decreasing the phytosanitary risk

1. Are there any measures in place to restrain and control the harmful organism?

- Prior to planting plants in the field – Yes. Healthy planting material.
- After harvesting – No.

2. The phytosanitary requirements applied to the vegetative products (goods) which may prevent the introduction of the harmful organism.

Vegetative products (goods)	Phytosanitary requirements
Grapevine planting material ( <i>Vitis vinifera</i> )	Certified grapevine planting material: permission to import grapevine planting material certified for the absence of GRLDaV (from the countries where the virus is reported: Greece, Italy, Turkey, Croatia) or mandatory testing of imported grapevine planting material for the presence of GRLDaV (from areas where such certification is absent)

3. Further work to decrease the level of uncertainty

Further studies should be conducted to evaluate the risks of GRLDaV for tablegrape and wine production based on the study of the virus, its biology (including its possible vectors), epidemiology, and distribution. In addition, a nationwide survey should be planned and executed to determine the possible presence of the virus in Ukraine. Further research to identify possible natural virus vectors and to develop methods of (latent) GRLDaV diagnostics are needed. Finally additional studies on prevention and control of the virus (including breeding for resistance) are also required.

## DISCUSSION

After the introduction of *Grapevine Roditis leaf discoloration-associated virus* into the EPPO Alert list in 2018, a few member-states of the organization (Great Britain and Russia) initiated a pest risk assessment (PRA) (UK Risk Register, 2020; Karimova, Shneyder, 2020).

Russia recommended to include the virus in the Unified list of quarantine organisms. In addition, Russia planned to establish a separate list of harmful organisms with quarantine status and potentially dangerous for grapevine, which, apart from GRLDaV also should include *Grapevine red blotch (-associated) virus* (GRBV) and *Grapevine vein clearing virus* (GVCV) (Shneyder et al, 2020).

The outcome of the British PRA was that GRLDaV was of insignificant risk for this country (UK Risk Register, 2020).

An express PRA for GRLDaV for Ukraine is described in this article for the first time where it is concluded that the virus may be introduced in the country with infected grapevine planting material. There is also a possibility of further spread of the virus once introduced in the grapevine growing areas described as possibly vulnerable, given the climatic conditions. These areas are namely in Odesa, Mykolayiv, and Kherson regions, in the south of Zaporizhzhia region, in the insignificant part of the south of Dnipropetrovsk region, in the Transcarpathian and Lviv region, in the west of Volyn region, and in the Autonomous Republic of Crimea (AR of Crimea).

In Ukraine, industrial grapevine production is mainly concentrated in the south of the country (Odesa, Kherson, Mykolayiv, Zaporizhzhia regions, AR of Crimea) and in the Transcarpathian region. However, grapevine is successfully cultivated throughout the entire country, due to presence of suitable soil, favorable climate, and availability of highly productive zoned cultivars of grapevine (the State register of plant varieties, 2021).

The cultivation of grapevine with subsequent meeting the population's demand for fresh table grapes and providing the wine-producing industry with raw materials for further processing is one promising and economically profitable direction for Ukraine. However, from 1990 till 2020, grapevine production witnessed a permanent negative tendency of decreasing the area of vineyards. During this period, the harvested area of vineyards decreased from 143.3 to 37.2 thousand

hectares, the production quantity decreased from 835.7 to 281.0 thousand tons, and the yield dropped from 5.83 to 3.72 tons/ha (Fig. 4) (Agriculture of Ukraine, 2021).

To stimulate the development of the viticulture (table grape and wine production) in the near future, the industry program in Ukraine envisages the additional planting of 13.7 thousand hectares of vineyards in the southern regions of Ukraine. By 2025, the area of vineyards in Ukraine is supposed to have reached 125.6 thousand ha, with a production of 967.8 thousand tons (NB: wine and/or table grapes? Not clear) (On Approving..., 2008; Ilchuk, Dmytruk, 2019). This ambitious program will require a considerable number of grapevine planting material, including imported ones, which will increase the risk of bringing GRLDaV-infected planting materials into the country, when they originate from infected areas in the mentioned EU countries where it has been reported till so far.

The damage to grapevine with GRLDaV may result in a decrease in the yield and in product quality which may have a negative effect on the country's economy, although very little data on the actual damage of the virus exist in the international literature. Potentially visual import inspections in a nation-wide survey should also be supplemented by checks for latent infections, which may result in increased production expenses (EPPO Alert List, 2018).

Although a possible effective means of mitigating the phytosanitary risk for Ukraine may be the prohibition of importing grapevine planting material from the countries with GRLDaV-infected vineyards, the observed and evaluated risks by us do not warrant such a measure at present and therefore it is advised to include GRLDaV in the the List of Regulated Non-Quarantine Harmful Organisms, (as per the Law of Ukraine "On Quarantine of Plants", 1993).

## CONCLUSIONS

There is a possibility of the introduction, further spread, and harmfulness of *Grapevine Roditis leaf discoloration-associated virus* (GRLDaV) in Ukraine due to a widespread occurrence of its host plant (grapevine, *Vitis vinifera ssp. vinifera* L.) and the relevant climatic conditions in the southern and some parts of western Ukraine, where grapevine are industrially cultivated.

The introduction of GRLDaV into Ukraine is possible via importation of GRLDaV-infected grapevine planting material from the countries where the virus is present.

The current Ukrainian phytosanitary measures cannot reliably prevent the risk of importing the GRLDaV into Ukraine.

An efficient measure of risk mitigation may be found in inclusion of GRLDaV into the List of the Regulated Non-Quarantine Harmful Organisms of Ukraine with the recommendation of permission to import the grapevine planting material, certified as GRLDaV-free, from the countries where the virus has been reported or mandatory inspection of the planting material for the presence of GRLDaV where such certification does not exist.

It is also recommended to organize a nation-wide survey of vineyards in Ukraine to determine the likelihood of the presence of GRLDaV in the region.

Further research to identify possible natural virus vectors, to develop methods of (latent) GRLDaV diagnostics are needed.

Finally additional studies on prevention and control of the virus (including breeding for resistance) are also required

**Compliance with ethical standards.** No experiments, described in this article, involved animals.

**Conflict of interest.** The authors declare the absence of any conflict of interest.

**Financing.** This study was conducted within the framework of the task of fundamental research 24.06.02.02.Ф, No. DR 0121U000079, UAH 280 thousand for 2021.

#### ***Grapevine roditis leaf Discoloration-associated virus: експрес-аналіз фітосанітарного ризику для України***

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**Мета.** Проведення експрес-аналізу фітосанітарного ризику для України *Grapevine roditis leaf discoloration-associated virus*: вірусу, що викликає захворювання виноградної лози та включеного до Сигнального списку ЄОКЗР у 2018 р. **Методи.** Аналіз фітосанітарного ризику проводили відповідно до методичних рекомендацій (Пулуєнко et al, 2012), стандартів ЄОКЗР і на підставі аналітичного огляду спеціалізованої літератури. Можливість акліматизації та потенційний ареал визначали за допомогою пакетів сучасних комп'ютерних про-

грам AgroAtlas (Afonin and Li, 2011; Shumilin and Li, 2009), MapInfo Pro15.0 (ESTIMap®) та IDRISI SELVA (Clarklabs®). **Результати.** Проведено експрес-аналіз фітосанітарного ризику для України збудника захворювання виноградної лози *Grapevine roditis leaf discoloration-associated virus* (GRLDaV), вогнища якого були вперше виявлені у чотирьох країнах ЄС: Греції у 1980-х роках (Rumbos, Avgelis, 1989) та пізніше (2014–2018) – в Італії (Chiumenti et al, 2015, 2016; Maliogka et al, 2015), Туреччині (Adan, 2016; Serçe et al, 2018) і Хорватії (Vončina et al, 2018). Встановлено, що наявність винограду, що мають велике економічне значення для країни, є одним із факторів ризику, оскільки виноградна лоза є єдиною рослиною – господарем патогену. Проаналізовано кліматичні предиктори у вогнищах країн, де виявлено збудник захворювання. Встановлено потенційну зону поширення GRLDaV в Україні у разі ввезення посадкового матеріалу та подальшого розповсюдження патогену. Запропоновано заходи з управління фітосанітарним ризиком, які передбачають включення *Grapevine Roditis leaf discoloration-associated virus* до списку Регульованих некарантинних шкідливих організмів України. **Висновки.** Існує ймовірність інтродукції, акліматизації та шкідливості *Grapevine Roditis leaf discoloration-associated virus* в Україні, що зумовлено наявністю рослини-господаря (виноград, *Vitis vinifera* ssp. *vinifera* L.) а також відповідними кліматичними умовами півдня України та частини Західної України, де його вирощують у промислових масштабах. Інтродукція *Grapevine Roditis leaf discoloration-associated virus* в Україну можлива внаслідок імпорту GRLDaV – інфікованого садивного матеріалу винограду з країн, де є патоген. Існуючі фітосанітарні заходи не можуть надійно запобігти ризику ввезення шкідливого організму *Grapevine Roditis leaf discoloration-associated virus* в Україну. В якості ефективного заходу управління ризиком може бути включення *Grapevine Roditis leaf discoloration-associated virus* до списку Регульованих некарантинних шкідливих організмів України з рекомендацією обов'язкової перевірки посадкового матеріалу на відсутність GRLDaV або дозволом імпорту саджанців, сертифікованих на відсутність GRLDaV з країн світу, де зареєстрований патоген. Рекомендується проводити моніторинг винограду на території України для визначення ймовірності присутності GRLDaV у регіоні. Потрібні подальші дослідження для виявлення можливих природних векторів вірусу та розробки методів (латентної) діагностики GRLDaV. Нарешті, також необхідні додаткові дослідження з профілактики та контролю вірусу (включаючи селекцію на стійкість).

**Ключові слова:** GRLDaV, *Vitis vinifera*, географічне поширення.

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