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GRAPEVINE PESTS AND DISEASES UNDER CLIMATE CHANGE IN UKRAINE

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Summary. An attempt to assess the meteorological factors and climate changes influence on grape pests and diseases was made. Using the example of grape berry moth, it is shown that temperature changes over a period of approximately 25 years (1988-1989 and 2014-2015 periods) affect the biophenology of the pest, changes in the dates of the indicators amount to an average of 7-10 days. The existence of a correlation between the number of days with a temperature above 25 °C and the grape berry moth flight duration was shown (r=0.66). Detection of grapevine virus disease leafroll symptoms on the 'Odesa Black' variety in 1987-1991 and 2001-2005 showed a number of diseased plants increase from 1.5 to 7.2 %. Correlation analysis showed that the main factor that most affects the manifestation of leafroll symptoms is the amount of precipitation during the vegetation period. Positive correlation between the development of grape trunk disease esca symptoms on the 'Dobrynya' rootstock and wine variety 'Cabernet Sauvignon' and the average monthly temperature during the growing season (June-August, (r = 0.77 and r = 0.595) was observed

Keywords: climatic changes, weather conditions, grape berry moth, grapevine esca, grapevine leafroll disease, vineyards protection.

Introduction

The influence of climatic changes on grapevine pests and diseases proven by the works of scientists from many wine-growing countries of the world [1, 2]. In relation to grape pests, these changes concern mainly the size of the population, biophenology changes, levels of damage etc. [3]. The specified changes were detected for such objects as grape berry moth, grape mites and leafhoppers. Regarding grape diseases, it is about the prevalence of the disease and the degree of damage, the objects include the most common fungal diseases (mildew, oidium), fungal diseases of perennial grape wood and some viral diseases. Very often, the effects of climate change are recorded in the case of pathogens affecting grapevine vascular system (virus disease – grapevine leafroll and rugose wood) and among diseases caused by fungal pathogens – grapevine trunk diseases - esca, eutyposis, excoriosis) [4, 5]. One of the most common diseases of this group is esca, which, like most diseases of grapevine perennial wood, causes vascular lesions. The disease development and the time of its symptoms manifestation are influenced by abiotic conditions, primarily humidity and air temperature [6]. If in the case of virus and fungal diseases of grapevine perennial wood, the control measures are mainly focused on obtaining healthy planting material, then the spread of downy mildew and powdery mildew is limited by improving the schemes for the vineyards protection [7]. This includes techniques for monitoring of disease manifestations dynamics, reducing the number of treatments while increasing the effectiveness of the pesticides

used, and including biologically active substances and their complexes in protection schemes, in addition to the actual protective substances.

The purpose of the research was to assess the impact of weather conditions and climate change on grape pests (grape berry moth example), fungal diseases (esca example), grapevine virus diseases (grapevine leafroll disease).

Material and methods

Monitoring of grapevine diseases development, visual sanitary control of grapevine leafroll and esca symptoms, ELISA detection of the grapevine leafroll 1 and 3, PCR and sequencing to detect the complex of grapevine esca pathogens.

Results and discussion

Grape berry moth. Annual observations of grapevine pests make it possible to draw a conclusion about the influence of the year weather conditions on their population (mites, leafhoppers), and in the case of multi-year observations (grape berry moth) also about the climatic changes influence. In relation to grape berry moth, the differences in biophenology (time of flight duration, date of biophenology periods were observed (Table 1).

Table 1

Biophenology of grape berry moth (Lobesia botrana Den. et Schiff.), ННЦ «ІВіВ ім. В. Є. Таїрова», порівняння періодів 1988 – 1989 та 2014 - 2015 рр

Year of obzervation	Biophenology indicators	Generation		
		I	II	III
1988 - 1989	Beginning of grape moth flight	April 27th May 9th	June 02 – July 10	July 29 – August 05
	Beginning of larvae hatching	May 12 th - May 21 -	July 8 – August 03	August 27 – Septembet 4th
	Grapevine moth flight duration (days)	29	31	30
2014 -2015	Beginning of grape moth flight	19.04 - 02.05	09.06 – 26.06	03.08 – 09.08
	Beginning of larvae hatching	01.05 – 14.05	21.06 – 08.07	16.08 – 21.08
	Grapevine moth flight duration (days)	38	37	38

The data changes of grape moth biophenology indicators analysis (1988 – 1989 and 2014 – 2015 periods) demonstrates that all the indicators (start of flight, start of larvae hatching and flight duration) differ by at least 7 – 10 days. As an example, first progeny of grape berry moth flight in 1988 – 1989 period began on 27th of April – 9th of May, but in 2014 – 2015 a bit earlier, 19th of April – 2th of May. Approximately the same differences in dates (seven days or a little more) was found to flight beginning indicator of the second and third generation of grape berry moth.

Figure 1 and 2 demonstrate an increase of average decadal temperatures and days with temperatures above 25°C during periods of observations (May – August).

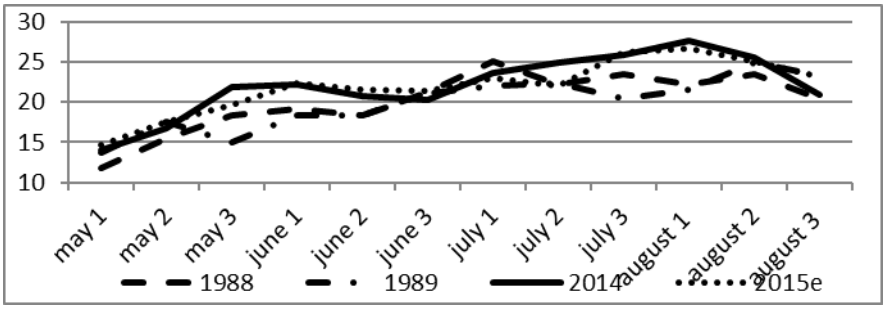


Figure 1. Average decadal temperatures for 1988 – 1989 and 2014 – 2015 periods of observations (May – August) (OX – month, OY - °C)

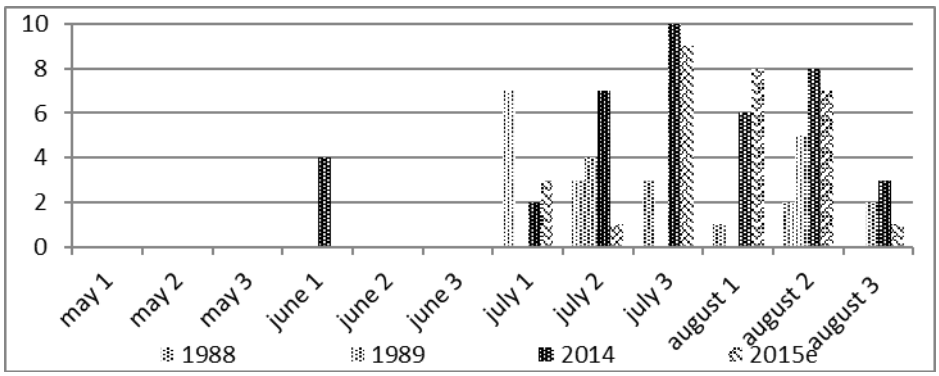


Figure 2. Days with temperatures above 25°C (May – August 1988-1989 and 2014 – 2015) (OX – month, OY – days)

The existence of a correlation between the number of days with temperatures above 25 °C and the duration of flight of cluster leafhopper butterflies was shown (r=0.66).

Grapevine trunk diseases (esca). With regard to grapevine trunk diseases, dependencies of temperature and precipitation influence on disease symptoms can be more complex. For example, the level of esca manifestation on the 'Dobrynya' rootstock variety (by the number of affected vines) in the vineyard from 2014 to 2016 was recognized as a slight fluctuation. Spatio-temporal observation of the esca symptoms manifestation demonstrated that over 3 years the number of vines with pre-esca symptoms increased from 10 to 17, with esca symptoms - from 25 to 28. In the growing season of 2017, a sharp decrease in the number of vines with pre-esca and esca symptoms, as well as the degree of symptoms manifestation were observed.

Since esca is characterized by fluctuations in the symptoms manifestation both during the growing season and in different years (growing seasons), an analysis of meteorological conditions during the study period was conducted to identify potential reasons for the increase/decrease in the levels of damage and symptom manifestation. For the analysis, the factors that, according to the literature, have the greatest influence on the appearance of esca - temperature and humidity were chosen. The conducted correlation analysis showed that the closest relationship is observed between the development of esca symptoms on the 'Dobrynya' rootstock variety and wine variety 'Cabernet Sauvignon' and the average monthly temperature during the growing season (June-August). Correlation coefficients were (r = 0.77) and (r = 0.595), respectively.

Grapevine virus disease (Grapevine leafroll disease, GLRaV). Grapevine leafroll belongs to diseases whose manifestation is significantly influenced by meteorological conditions of the current year, in particular, hot and dry weather. Detection of leafroll on the Odesa Black variety in 1987-1991 and 2001-2005 showed a gradual increase in the number of diseased plants in the vineyards of the “Tairovske” Experimental State Enterprise (NAAS) from 1.5 to 4.6% with symptoms of color change - redness between veins - and twisting the edges of the leaf downwards. In the period from 2010 to 2015, this increase reached 7.2%, however, the specified changes in color were partly related to perennial wood damage by disease. Correlation analysis showed that the main factor that most affects the manifestation of leafroll is the amount of precipitation during the period of disease symptoms manifestation. It is known that leafroll virus primarily affects grapevine vascular system (phloem) of grapes. A decrease in the amount of precipitation additionally worsens its functioning, which is manifested in leaf functioning changes, the external manifestation of which is leaf rolling and colour change from green to red. The effect of the thermal regime on leafroll is much smaller, which is manifested in a slight correlation between the level of symptoms manifestation and the number of days with an average daily temperature above 25 ˚C.

Improvement of protection and prevention measures

The spread of grapevine fungal diseases, which has been observed in recent years (downy mildew, powdery mildew and rots) and grapevine pests development are limited by improving schemes for the vineyards protection at NSC "Tairov Research Institute of Viticulture and Wine-Making" In addition to constant monitoring of symptoms development, especially in rainy vegetation seasons, highly effective pesticides of the latest generation (Topaz, Pergado, Dinali) are used, but the number of treatments against diseases, compared to European systems, is reduced by 2-3 treatments (Table 2.). Protection system also includes Izabion - a biofertilizer and stimulator that contains amino acids, macro- and microelements and promotes the full development of the grape plant. In relation to chronic grapevine diseases, the main method of prophylactic and protection remains the use of healthy planting material for vineyards establishing and limiting the spread of diseases within the plot (due to the limit of grape virus vectors etc).

Conclusions

The impact of temperature changes (increase in the average decadal temperature and the number of days with temperatures above 25 °C) on the grape berry moth biophenology was revealed, namely on the change in the dates of the flight beginning, the larvae hathing beginning by approximately 7-10 days (earlier in the period of 2014 - 2015 compared to the period 1988 - 1989) and change of flight duration by approximately 7 days. The existence of a correlation between the number of days with a temperature above 25 °C and the grape berry moth flight duration was shown (r=0.66).

Changes in temperature and humidity contribute to the progression of diseases that affect grapevine vascular system. Positive correlation is observed between the development of grape trunk disease esca symptoms on the 'Dobrynya' rootstock and wine variety 'Cabernet Sauvignon' and the average monthly temperature during the growing season (June-August, ($r = 0.77$ and $r = 0.595$). Detection of grapevine virus disease leafroll symptoms on the 'Odesa Black' variety in 1987-1991 and 2001-2005 showed a gradual increase in the number of diseased plants in the vineyards (from 1.5 to 7.2 %).. Correlation analysis showed that the main factor that most affects the manifestation of leafroll symptoms is the amount of precipitation during the vegetation period.

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