Selections on domestic grape pests

Szemelvények a hazai szőlőkártevőkről

András Hágen[1], Pál Sümegi [2]

[1]*Déli ASZC Máté Bereczki Agricultural and Food Industry Technical School, Vocational Training School, 6500 Baja. Szent Antal u. 96.*

[2]*University of Szeged, Faculty of Natural Sciences and Informatics. Department of Geology and Paleontology. 6720 Szeged, Egyetem u. 2.*

Correspondance: hagena@freemail.hu

Abstract: Climate fluctuation has turned into climate change in the last 10-20 years, the results of which can be seen in extreme weather events. From a climatic point of view, our country is divided into three sub-zones, of which the first sub-zone is warm-temperate or Mediterranean, the second sub-zone is medium-temperate, while the third sub-zone is cold-temperate. So it is essential to monitor the climate changes of these subzones in the future. Since the transformation of the flora requires a relatively long time, witch these pest insects world does not, therefore the change in the climate of our country is already noticeable, which is connected with the completion of globalized networks and the arrival of insects in a new environment. Such new damage recipients in grape culture are the green wandering bug (*Nezera viridula* LINNAEUS 1758), the american grape cicada (*Scaphoideus titanus* BALL 1932), the snake-mining vine moth (*Phyllocnistis vitegenella* CLEMENS 1859), the grape-mining bright moth (*Antispila oinophylla* VAN NIENKERKEN & WAGNER 2012) and the small glow moth (*Holocacista rivillei* STAINTON 1855). Two of these are interesting because of global climate change, two are interesting because of globalized trade, and one is interesting partly because of trade and partly because of climate change.

Keywords: *climate change, climate zones, Mediterranean insects, invasive insects, boiotic reasons, abiotic reasons*

Összefoglalás: Az éghajlatingadozás klímaváltozássá alakult az elmúlt 10-20 évben, amelyek eredménye a szélsőséges időjárási eseményeken is meglátszik. Hazánk éghajlati szempontból három alzónára tagolódik, ezek közül az első alzóna a meleg-mérséklet vagy mediterrán, a második alzóna a közepesen-mérséklet, míg a harmadik alzóna a hideg-mérsékelt. Természetesen ezek az alzónák meghatározzák, hogy bizonyos területeken milyen növényt termesztünk gazdaságilag optimális befektetéssel, ezért elengedhetetlen, hogy nyomon kövessük ezeknek az alzónáknak az éghajlati változásait a jövőben.Mivel a növényvilág átalakulása viszonylag hosszú időt igényel, a rovarvilágé nem, ezért már észrevehető hazánk klímájának megváltozása, amelyhez kapcsolódik a globalizált hálózatok kiteljesedésével a rovarok új környezetbe kerülése.Ilyen új kártvevők a szőlő kultúrábana zöld vándorpoloska (*Nezera viridula* LINNAEUS 1758), az amerikai szőlőkabóca (*Scaphoideus titanus* BALL 1932), kígyóaknás szőlőmoly (*Phyllocnistis vitegenella* CLEMENS 1859), a szőlőaknázó fényesmoly (*Antispila oinophylla* VAN NIENKERKEN & WAGNER 2012), és a kis fénymoly (*Holocacista rivillei* STAINTON 1855). Ezek közül kettő, amely a globális éghajlatváltozás miatt érdekes, kettő a globalizált kereskedelem miatt, egy pedig részben a kereskedelem,

részben a klímaváltozás miatt érdekes. A továbbiakban nem elképzelhetetlen további délebbről, a mediterrán éghajlat irányából érkező rovarok megjelenése.

Kulcsszavak: *klímaváltozás, klímazónák, mediterrán rovarok, inváziós rovarok, boiotikus ok, abiotikus ok.*

1 Introduction

According to the fossilized seeds, the ancient varieties of the grape genus appeared in the warm-temperate climate zone in the Pliocene period. During the Ice Age, their production area shrank. In the Holocene after the ice age, different grape species appeared in the refugia, which began to spread within the northern flora kingdom (holarctic) due to the heat. The forest grape (*Vitis silvertis* GMELIN 1805) achieved its greatest success in the territory of today's Iran, Armenia and Azerbaijan 4-5,000 years ago. The wine-producing grape (*Vitis vinifera* LINNAEUS 1753) developed from this 2-3,000 years ago.

In the area of the Carpathian basin, viticulture appeared as early as the Roman period. After the fall of the Roman Empire and during the period of migration, the grape almost died out, and then flourished again in the Middle Ages. Grapes were mostly grown in areas suitable for it, in designated majorities, as well as in church areas. Harvests were held simultaneously. The date was determined by the council, each grape variety based on its clusters.

Berkes (1942) established that climate fluctuations can best be traced in the phenomena of plant physiology (phenology) of grapes. In the Kőszeg museum, you can find the "Book of Grape Harvest", which has been reporting on the phenological phase of the noble plant and the length of the grape shoots since 1740. According to Berkes' research, strong temperature fluctuations have occurred in the last 150-200 years. Based on the samples from Kőszeg, Budapest, Vienna and Berlin, the average annual temperature fell everywhere from 1790 to 1860, and has risen since then (Figure 1). The minimum temperature falls between 1850-60. So there is a strong correlation between shoot length and temperature. This shows that the shoot lengths in Kőszeg were the largest between 1740 and 1780, so the spring temperature was basically warmer.

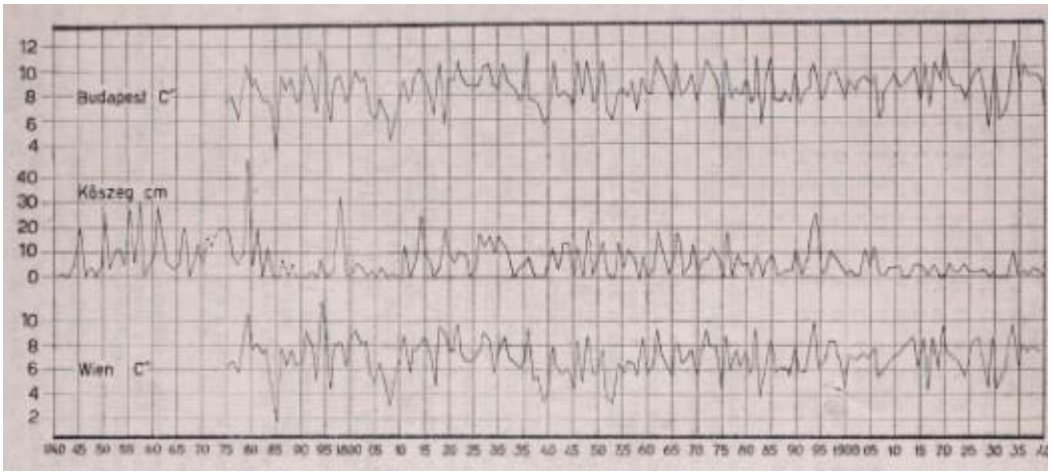

Figure 1 *Length of vine shoots in Budapest, Kőszeg and Vienna from 1740 to 1940 (Berkes 1942)*

Benedeffy (1972) compared the phenological data of grapes from three locations. The archives in Sopron contained data from 1576 until 1763 with few interruptions. In Kőszeg from 1649 to 1820 in the "Book of Grape Harvest". He also examined the samples from Kecskemét, which

were recorded from 1698 until 1830. He also examined the data from Szombathely, one part of which covers from 1668 to 1704, and the second part from 1797 to 1848. The ripening times of the grapes show a regular periodicity, the duration of which is approx. 36 years. From Benedeffy's investigations, a 55-year period and a slightly curving 210-220-year period can be detected in the air temperature conditions.

The last decades have proven that our climate is warming, but what does the future hold for us, to what extent will it warm, and how will the precipitation map of our country change, as well as what effect this will have on the basically little precipitation (depending on the location, one vine consumes 4-14 liters of water) for demanding viticulture. We are looking for an answer to this in the following.

2 Matherials and Methods

It is necessary to examine the climate system from two fundamental points of view. According to one, it is necessary to examine how the system works, while according to the other, it is necessary to examine how it affects the environment and the human activity carried out in it (Varga-Haszonits 2003).

If we want to find out about the future development of the climate, there are two possibilities (Easterling et al. 1992):

1. We assume that the climate does not change. According to this, the climatic elements will fluctuate between the many-year average.
2. We assume that it changes, then its change can be analyzed and detected by statistical tests. It will be similar to past analogies, and may be modeled with general circulation models.

The scenario of the evolution of the climate is the assumption based on analogy and the estimation of the global climate models can be proposed (Varga-Haszonits 2003).

In this study, we basically list the climatological scenarios, from which the conclusion can be drawn that our climate will warm and the amount of precipitation will become fluctuating and extreme.

We examine five grape pests, whether they are invasive species or have arrived in their "new" environment due to global climate change.

This study shows how global climate change (warming, erratic rainfall intensity) creates a new environment in Hungarian farmlands.

3 Changes in climate zones

The fact of global climate change has become accepted nowadays. Climate change has and will have serious medical meteorological effects in the future (Bartholy et al. 2003, Bartholy et al. 2007). The changes affect not only the animal kingdom, but also the flora, albeit at a slower pace than the insects (Skendžić et al. 2021).

Hungary belongs to the temperate climate zone, where three sub-zones are distinguished:

The first is the warm-temperate or Mediterranean, the second is the mid-temperate and the third is the cold-temperate subzone. The variability within the belts is determined by the amount and distribution of precipitation. Borhidi (1961) was the first to show these climate zones on a map. Dobor et al. (2014) presented four periods in their analysis:

1. 1901-1950: The basic state;
2. 1970-2009: The onset of climate change;

3. 2011-2050: Acceleration of climate change;
4. 2051-2100: Peak climate change.

According to the analyses, those belonging to group 3 show an increase of around 2 °C. For group 4, the 2 °C limit is well exceeded (Table 1).

Table 1 The evolution of our country's climate in the future (Borhidi 2019)

Annual mean temperature averages (˚C)					
	1901-1950	*1970-2009*	*2011-2050*	*2051-2100*	*Difference*
National	9,8	10,5	11,4	13,1	3,3
NE-Hun.	9,2	9,9	10,7	12,7	3,5
Great Basin	11,2	11,9	12,9	14,9	3,7
S-Hun.	10,1	11,0	11,8	13,5	3,4

In addition to the temperature, a decrease in the amount of precipitation can also be forecast by an average of 58-60 mm per year (Borhidi 2019). This means a full month of precipitation loss per year, especially in the summer months. Borhidi (2019) drew an interesting conclusion between the climatic water balance, that is, the evaporative water loss and the climatic water income from precipitation. As a result, the climatic zone map of our country will change. So, due to the decrease in precipitation, the previously known montane or submontane beech in Kőszeg will be replaced by the end of the century by the hornbeam-oak currently populating South Transdanubia, that is vegetation that requires less precipitation.

Based on this, it can be concluded that the current grape culture and grape varieties are changing at the national level, including at the beginning of the Alps.

3.1 Pests in viticulture

We encounter many pests in grapes. Many species of insects can wreak havoc on crops. Listed below, we encounter such pests as the grape root bug (*Viteus vitifoliae* FITCH 1855), the vine beetle (*Otiorhynchus ligustici* LINNAEUS 1758), the leaf mite (*Calepitrimerus vitis* NALEPA 1905), the cotton bug (*Eriophyes vitis* HILGARDIA 1955), the spider mite, the plum borer (*Byctiscus betulae* LINNAEUS 1758) and many others.

In addition to the insects that have been found so far, there are other pests in our country.

1. green wandering bug (*Nezera viridula* LINNAEUS 1758);
2. american vine cicada (*Scaphoideus titanus* BALL 1932);
3. snake-mined vine moth (*Phyllocnistis vitegenella* CLEMENS 1859);
4. grape mining moth (*Antispila oinophylla* VAN NIENKERKEN & WAGNER 2012);
5. small bright moth (*Holocacista rivillei* STAINTON 1855).

The first two were basically moved from their "birthplace" to a foreign environment due to globalization. In its "new" location, it is a true invasive species that has adapted to the local climate and lives without natural enemies.

The green wandering bug lives in large numbers in tropical and subtropical areas, and was first observed in Hungary in 2002 (Vétek et al. 2014, Kóbor 2017). The american cicada is native to North America and came to Europe in 1958 with American root cuttings imported due to the phylloxera blight (Szolárdi et al. 2014).

The snake-mined vine moth is an intermediate pest, because it basically originates from North America, but was first detected in Italy in 1994, and then spread from there to neighboring Slovenia (2004), the southern part of Switzerland (2009) and Hungary (2014). This species can also be called an invasive species and a Mediterranean species (Pobleczki 2018).

The grape-mining moth came to our country from Italy. Its larvae damage the leaves of the grapes, which reduces the assimilation surface, and thus the sugar and acid content of the grapes deteriorates (Pastorális 2012).

The other insect coming from Italy is the small bright moth. Its damage is similar to that of the grape-mining moth.

So, the presented species spread in our country due to global trade and climate change.

4 Results

The history of the pest species we have examined can be traced very well from scientific records and farmers' comments. Two types, the green wandering bug (*Nezara viridula* LINNAEUS 1758) and the american vine cicada (*Scaphoideus titanus BALL 1932*), are cosmopolitan species, so they can survive in other environments where the conditions are right. In other words, invasive species.

The snake-mined vine moth (*Phyllocnistis vitegenella* CLEMENS 1859) is considered an eccentric, as it lives in the Mediterranean regions of America, but it did not come directly to our country, it came from northern Italy. So it is both an invasive species and a pest from the Mediterranean area, but not in the literal sense.

The grape mining moth (*Antispila oinophylla* VAN NIENKERKEN & WAGNER 2012) and the small bright moth (*Holocacista rivillei* STAINTON 1855) species came to our country from Mediterranean areas due to global climate change.

5 Discussion

The phenological phases of species belonging to the grape genus show a strong correlation with climate change. This can be traced in the research of Berkes and Benedeffy, detected in the growth of vines.

The current state is supported by climate maps (Borhidi 2019). In terms of climate change in the future, the rate of change can be divided into four time units. As for the future, we have to pay attention to the last 2 stages. Based on these, in the 3rd stage (2011-2050), the temperature increase below 2˚C will be kept narrowly, but in the period after 2050 we will exceed 2˚C.

And the amount of precipitation will change drastically (Rakonczai 2006). An entire month's amount of precipitation will be missing, and as a result, the vegetation zone of our country will probably also be rearranged. In terms of grapes, the grape varieties typical of a given area will no longer be relevant in the future, so other varieties that manage with little rainfall and are economically profitable will spread.

Basically, the migration of animal species is a natural process to find a suitable habitat for them. The reasons for migration can be biotic and abiotic. The biotic causes are a decrease in the amount of food, disease, overgrowth of the species (gradation), or possibly the appearance of a competing insect population. Abiotic causes include changes in climate, temperature or soil.

Of the five species we have presented, two are species that came from the Mediterranean area for biotic reasons (invasion species), and two for abiotic reasons.

Among the pest insects in the grape culture of our country, in addition to the usual species, invasive species and species arriving here from the Mediterranean areas will be observed (Venette - Hutchinson 2021, Reineke - Thiéry 2016). Of the five species we have presented, two are invasive species, and two are species introduced from the Mediterranean area. The snake-mined vine moth is partly an invasive species, because it was brought from North America to the northern part of Italy, so it entered our country from a relatively Mediterranean area.

If the scenario of Dobor et al. (2014) really comes true (and it probably will), the grape culture of our country will fundamentally change in terms of varieties and new pests.

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