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THE INFLUENCE OF THE CLIMATE ON THE EVOLUTION OF DISEASES IN THE SAUVIGNON BLANC VARIETY IN THE CONDITIONS OF THE YEARS 2021-2022 IN MURFATLAR

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Abstract

The years 2021 and 2022 evolved differently from a climatic point of view, one being particularly rainy and the other being relatively dry. During this period, through the ERA-Net MERIAVINO project, studies were carried out on the Sauvignon blanc variety treated and untreated variants with phytosanitary protection substances regarding the degree of attack on the main diseases - Downy Mildew, Powdery Mildew and Gray Rot, along with determinations regarding stomatal conductance and sensor recordings for leaf humidity. The determinations that were made showed that the climatic factors, especially the precipitation and the relative humidity of the air have an uneven distribution during the vegetation period; determine the occurrence of cryptogamic diseases and have a great influence over the rate of extension of grapevine diseases (GA). In 2021, the degree of pathogen attack was higher compared to 2022, being directly correlated with the value of leaf humidity and also, the stomatal conductance determined for 4 days immediately after the appearance of the first symptoms of Plasmopara viticola and Botrytis cinerea infections recorded decreasing values.

Key words: *diseases, grapevine, leaf humidity, stomatal conductance, untreated.*

INTRODUCTION

The wine production health status is strongly influenced by the annual evolution of environmental factors. The abiotic factors are represented by the climate, and the biotic ones by the development of cryptogamic diseases and pests.

Observations carried out over the years, regarding the appearance, spread and evolution in time and space of the main phytopathogenic agents of the grapevine: grapevine Downy Mildew (*Plasmopara viticola*, Berk. & M.A. Curtis - Berl. & De Toni), Powdery Mildew (*Uncinula necator*, Schwein) and Gray Rot (*Botrytis cinerea* Pers.) revealed different levels of attack, depending on the climatic conditions of each year (Bois et al., 2017; Caffarra et al., 2012), and the presence of the inoculum, disease history and variety sensitivity (Tomoioaga, 2013).

Phytopathogens strongly act on the plant at the biochemical, physiological and anatomical-morphological levels (Moriondo et al., 2005). The stomata constitute areas of penetration to the leaf tissues for numerous pathogens such as bacteria, fungi such as *Plasmopara viticola*. Many pathogens induce the closing of the stomata, and in some cases induce their abnormal opening and accentuate the loss of water from the plant (Duniway et al., 1971).

Monitoring the evolution of pathogens, time and development phases plays an important role in the detection and optimal treatment of diseases and has an important impact on the improvement of production and its quality. Pathological processes lead to physiological changes and affect the amount of biomass produced by each individual plant (Rabbinge et al., 1989). The decrease in biomass accumulation in plants affected by pathogens is caused by the appearance of necrotic points on the leaves, which leads to a decrease in the surface of the leaf apparatus and the interception of photons. Necrotic spots are associated with decreased photosynthetic efficiency in dead leaf tissues, but also in adjacent or intact areas of the leaf, leading to decreased CO_2 assimilation in affected tissues and leaving CO_2 assimilation intact in the rest of the leaf surface with healthy tissue.

To ensure a sustainable agriculture, it is necessary to monitor the health of plants to limit the spread of diseases and to reduce the degree of production damage (Van Oijen, 1990).

MATERIALS AND METHODS

The study was carried out in 2021 and 2022 on the Sauvignon blanc variety from the vineyard plantations at the MURFATLAR Research Station for Viticulture and Oenology. The plantation cultivated with the Sauvignon blanc variety grafted on Berlandieri x Riparia Sel rootstocks. Opp. 4-4 was established in 2011, having a slope distance of 2.2/1.1 m, semi-tall Guyot driving form with 70 cm stem, bilateral cord..

The soil maintenance system kept the soil bare. The experimental lot had an untreated and a treated variant.

In the untreated experimental variants, in order to stimulate the infection with *Plasmopara viticola, Uncinula necator* and *Botrytis cinerea*, optimal conditions were created: the leaf apparatus was moistened periodically and permanent surfaces with water were created under the selected trunk, to stimulate the spread of *Plasmopara viticola* and *Botrytis cinerea*, and in the treated areas phytosanitary treatments for prevention and control were carried out year after year.

To monitor the climatic elements, the weather station (iMetos 3.3), located in the center of the vineyard, was used. To identify the vegetation phenophases of the grapevine, the BBCH Lorenz Scale (Lorenz et al., 1995) was used, and to determine the frequency (F %), intensity (I %) and degree of attack (G.A. %) the visual graphic scale described by Buffara was used for the leaves (Buffara et al., 2014), based on seven levels of disease severity: 1, 3, 6, 12, 25, 50, and 75%, and for clusters, the scale diagram with the seven levels of disease severity: 5, 15, 25 , 35, 50, 75 and 100% - Caffi (Caffi et al., 2010).

Monitoring of pathogen evolution, time and development phases was carried out twice a week.

During the observations, in 2022, the stomatal conductance was determined with the "Steady State" porometer over leaves infected with *Plasmopara viticola* and *Botrytis cinerea.*

For Downy mildew (*Plasmopara viticola*), measurements were made for 4 days during the incubation period (starting with BBCH 11, and 3-4 days from the moment the first spots appeared on the vine leaves (BBCH 11-19), and for Gray Rot (*Botrytis cinerea*), the measurements were made from the moment the first spots appeared on the clusters (BBCH 69-89).

RESULTS AND DISCUSSIONS

Climatic data

The climatic data of the years studied showed a large variation in the precipitation regime and an uneven distribution during the vegetation period, which caused pathogens to appear in all the years of the study, manifesting different levels of attack on the grapevine, depending on the climatic conditions and the vegetation phenophases.

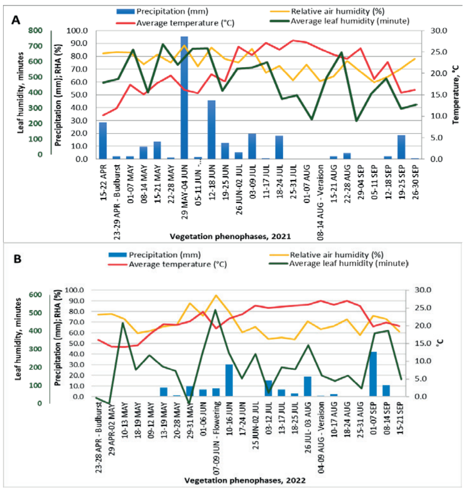

Figure 1. Climatic data and the main phenological stages of the grapevine, registered during the study period from April to September: in A, 2021 and in B, 2022

In 2021, during the growing season, precipitation totaled 339.3 mm and in 2022 they summed 206.7 mm.

As can be seen in Figure 1 A and B, the rainfalls recorded in the months of May and June created favorable conditions for the outbreak of the Downy Mildew (*Plasmopara viticola*) starting from May every year. The very high temperatures in the months of July and August of 2021 and the short intervals with atmospheric drought, the low humidity at the leaf level and the slightly increased temperatures above 25°C in the months of June, August and September of the year 2022 favored the late appearance of Powdery Mildew (*Uncinula necator*). Regarding the manifestation of Gray Rot (*Botrytis cinerea*) in 2021, it started with the beginning of veraison and in 2022, it set in after the downpour accompanied by hail on 14.06.2022, and evolved and amplified in intensity in the following months.

The evolution of diseases on phenophases of vegetation

In 2021, Downy Mildew was triggered in the untreated variant on 17.05.2021 (BBCH 15) and on 04.06.2021 in the treated variant and in 2022 the first Downy Mildew spots were identified on 14.06.2022 at both variants (untreated and treated).

Due to the large amount of precipitation recorded in the months of May, June and July, which maintained a hygroscopicity between 70 and 88% and a leaf humidity level over an average interval of 228-711 minutes, in the year 2021, the degree of attack in the plantation of the disease caused by the phytopathogenic agent *Plasmopara viticola* had a progressive increase in the untreated variant starting with the onset of flowering (BBCH 60) - GA = 6.46% and recorded a sudden increase when the berries stood out well within the cluster (BBCH 73), reaching a value of 27.24%. In the treated variant, the degree of attack on the leaves reached the value of 12.32% (BBCH 73) (Figure 2).

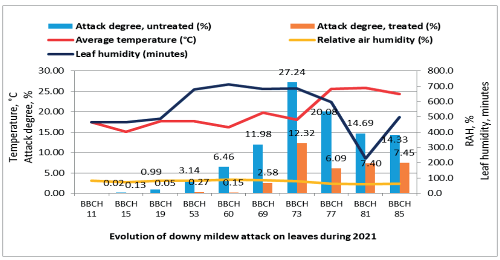

Figure 2 - The evolution of the Downy Mildew (*Plasmopara viticola*) on leaves in 2021

The degree of attack on grapes followed the same evolution, registering the highest point in the BBCH 73 phenophase. It had a value of 31.6% (Figure 3).

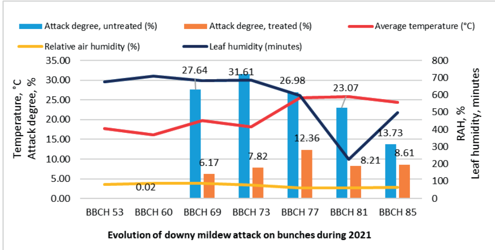

Figure 3. Evolution of Downy Mildew (*Plasmopara viticola*) on grapes in 2021

In 2022, the frequency and intensity of the attack produced by *Plasmopara viticola* on the leaf apparatus was very reduced, on the other hand, on grapes, in the untreated variant, the degree of attack recorded a percentage of 1.32% and 1.56% respectively (BBCH 69 and BBCH 73), this being determined by the rain shower accompanied by hail from 14.06.2022, by a hygroscopicity of 95.2% and an average leaf humidity that persisted for an average interval of 517 minutes (Figure 4).

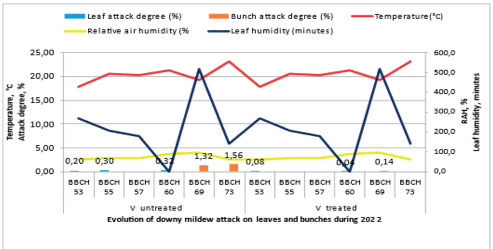

Figure 4. The evolution of Downy Mildew (*Plasmopara viticola*) on leaves and grapes in 2022

The Powdery Mildew (*Uncinula necator*) in the Murfatlar viticultural center manifests itself with a very high intensity due to the climatic conditions in the area very favorable for the appearance of the pathogen (very high air temperatures, very low atmospheric humidity). The first outbreaks of infection produced by *Uncinula necator* corresponded to the phenophase of growth and development of berries (BBCH 73) and was identified in the untreated variant on 22.06 2021. The degree of attack on the leaves was lower. On the other hand, there was an progressive evolution on the grapes at the beginning of the ripening of the berries (BBCH 81) - a degree of 4.99%.

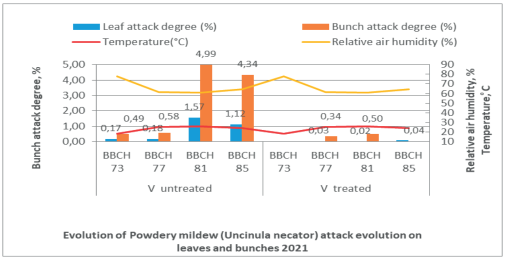

Figure 5. The evolution of the Powdery Mildew (*Uncinula necator*) on leaves and grapes in 2021

In the treated variant, the infection started when the clusters were compacted - BBCH 77 on 22.07.2021 and registered a higher degree of attack at the start of veraison (BBCH 85) - 0.50% (late infection), (Figure 5).

In 2022, the maximum degree of attack recorded on leaves was 0.30% (BBCH 53) and on grapes it reached 3.34% in the BBCH 73 phenophase (Figure 6).

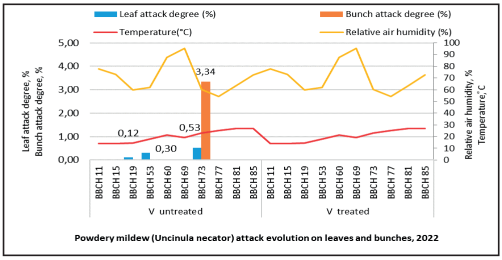

Figure 6. The evolution of the Powdery Mildew (*Uncinula necator*) on leaves and grapes in 2022

In Murfatlar, the Gray Rot (*Botrytis cinerea*), causes significant damages in rainy years, during the veraison and ripening period, and in dry periods it ennobles the quality of the harvest (Noble Rot). Both years were favorable for the development of the biological cycle of the Gray Rot (*Botrytis cinerea*) due to rainfalls, the relative air humidity and the high temperature at full maturity. In the year 2021, in the untreated variant, the infection with *Botrytis cinerea* was triggered, at the beginning of veraison (BBCH 81) and had a high degree of attack 27.64% in the grape maturity phenophase (BBCH 89). In the treated variant registered at full maturity BBCH 89, a percentage of 6.26% (Figure 7).

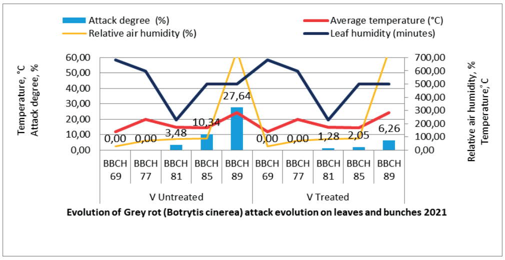

Figure 7. Evolution of the attack of gray rot (*Botrytis cinerea*) in 2021

In 2022, following the downpour accompanied by hail on 14.06.2022, which produced slight cuts on grapes, the infection with *Botrytis cinerea* was triggered, which evolved and increased in intensity in the following months, registering a high degree of attack - 14.32% in the untreated variant and was kept below 1.88% in the treated variant by applying specific phytosanitary treatments for Gray Rot (Figure 8).

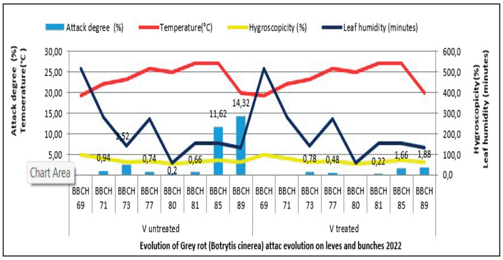

Figure 8. Attack evolution of Gray Rot (*Botrytis cinerea*) in 2022

Stomatal conductance

In 2022, during 4 consecutive days from the appearance of the first symptoms of infection with *Plasmopara viticola* (Figure 9), the stomatal conductance in the treated and untreated variants had a tendency to decrease, which means that the exchanges of gases between the plant and the environment are reduced with the increase in the intensity of the pathogen's attack. In the untreated variant, from values that reached 189.9 mmol/m^{2}s^{-1} on the first day, it decreased to 114.15 mmol/m^{2}s^{-1} on the last day of measurements, and in the treated variant, from 73.9 mmol/m^{2}s^{-1}, on the first day, to 55.48 mmol/m^{2}s^{-1} on the last day. The values determined in the untreated version were higher compared to those in the treated variant.

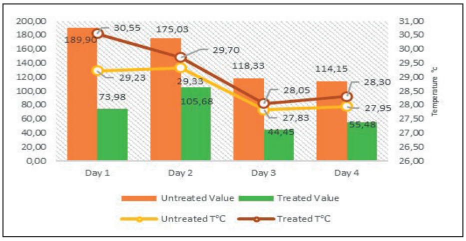

Figure 9. The evolution of the stomatal conductance measured in 2022, in the first 4 days after the appearance of the first symptoms produced by *Plasmopara viticola*

With the appearance of the first lesions on clusters, following the onset of the Gray Rot attack (*Botrytis cinerea*), in the 4 consecutive days of determinations, the stomatal conductance recorded decreasing values from 48.55 mmol/m^{2}s^{-1} on the first day to 11.59 mmol/m^{2}s^{-1} on the last day of observation (Figure 10).

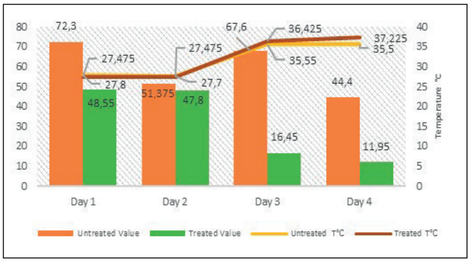

Figure 10. The evolution of the stomatal conductance measured in 2022, the first days after the onset of infection with *Botrytis cinerea*

CONCLUSIONS

The thermal oscillations and the uneven distribution of rainfalls during the growing season, relative air humidity and the persistence interval of leaf humidity, determined the occurrence of cryptogamic diseases and greatly influenced the rate of extension of vine diseases (GA). The aggressiveness of the diseases was higher in 2021 compared to 2022, and gas exchanges (stomatal conductance) recorded decreasing values in the first 4 days immediately after the appearance of the first symptoms of *Plasmopara viticola* and *Botrytis cinerea* infections. The correct development and application of a disease protection program cannot be achieved without the correct diagnosis, which requires specialized personnel, time and a large number of observations in the field. In this case, the accurate identification in the shortest possible time before the establishment of infections produced by pathogenic agents is an essential condition for the application of timely and economically effective treatment prevention measures.

ACKNOWLEDGEMENTS

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