BEHAVIOR OF DISEASE RESISTANT GRAPEVINE VARIETIES TO DOWNY MILDEW (*PLASMOPARA VITICOLA)* INFECTIONS IN THE CASTELLI ROMANI AREA (CENTRAL ITALY)

Authors: M. Antonietta PALOMBI[1*], Roberto NUTI [1], Luna CENTIONI [1], Nicola Calanducci[1], Luigi TARRICONE[2], M. Morassut, M. Cecilia SERRA[1]
[1]CREA, Council for Agricultural Research and Economics, Research Centre for Viticulture and Enology, Via Cantina Sperimentale, 00049 Velletri, (Rome) Italy.
[2] CREA, Council for Agricultural Research and Economics, Research Centre for Viticulture and Enology, Via Casamassima 148, 70010 Turi (BA), Italy
*Corresponding author : mariaantonietta.palombi@crea.gov.it

Abstract

At CREA – Centro di Ricerca di Viticoltura ed Enologia, based in Velletri (RM), an experimental vineyard including 10 downy mildew resistent/tolerant grape varieties and two susceptible varieties was set up with the principal goal to evaluate the behavoir of these varieties in term of resistance to downy mildew (*Plasmopara viticola*). This evaluation, together to oenological studies, are necessary to register them also in Regional Register (in Lazio region). Monitoring of behavior towards *Plasmopara viticulture* of resistant vines were done in 2020 and 2021 at different times (phenological stages) and until harvesting, according to an international standard code BBCH a centesimal phenological scale, based on coding system. Data analysis show differences in behaivor depending on the cultivar and the meteorological conditions during the two-year growing seasons.

Keywords: *Vitis vinifera L., grape desease, BBCH phenological scale*

1. Introduction

Grapevine is one of the most economically important fruit crops worldwide, but many cultivars used for table grape and wine production are susceptible to several diseases, such as downy mildew (caused by *Plasmopara viticola*) and powdery mildew (caused by *Erysiphe necator*). To control these deaseses frequent applications of chemical fungicides are require. However, the ecological drawbacks of pesticides and the rapid appearance of resistant pathogen strains have sparked crescent interest in sustainable control alternatives. The development of resistant grapevine hybrids represents a promising option to limit the application of chemical pesticides in viticulture. In Italy a national breeding program was conducted whit a collaboration among the University of Udine, the Institute of Applied Genomics and Vivai Cooperativi Rauscedo and ten resistant/tolerant grape varieties were obtained (AA.VV, 2019). These cultivars, already tested and spread in northern environments in Italy, need to be evaluate also in warm, to test their behavior in term of downy mildew resistance/tolerance. This evaluation is necessary not only in term of comparison of different environmental conditions but also because, in Italy, the introduction of new varieties in a vineyard area requires a compulsory registration in Regional Register, possible only after an agronomical/oenological evaluation. With this aim at CREA – Centro di Ricerca di Viticoltura ed Enologia, based in Velletri (RM), an experimental vineyard including 10 resistent/tolerant grape varieties was set up in 2018. The aim of this work is monitoring the behavior of these varieties in Castelli Romani growing area in comparison to susceptible varieties, respect to *Plasmopara viticola* infection.

2. Material and methods

Ten disease tolerant/resistant grapevine varieties (Fluertai, Sauvignon Kretos, Soreli, Merlot Kanthus, Julius, Cabernte Volos, Merlot Khorus, Sauvignon Nepis, Cabernet Eidos and Sauvignon Ritos) against powdery and downy mildew, were compared to susceptibile traditional varieties Trebbiano Toscano and Sangiovese. The tests were carried out in the experimental vineyard of CREA - Centro di Ricerca Viticoltura ed Enologia, in Velletri (Rome), 41° 40 .5' N latitude 12° 50.7' longitude E, at 322 m above sea level. The vineyard is located on a south facing soil. The vineyard formed by 12 rows of 80 vines (1 row per cultivar): 5 rows with 5 resistant white grapes and 5 rows with 5 red berry resistant vines. In the first row Trebbiano Toscano was planted, used as test for white grapes, while for red grapes the reference vine was Sangiovese, planted in the twelfth row (Fig. 1). Plant distance: (1.0 m x 2.5 m), 4,000 vines per hectare; without definitive training system.

The meteorological conditions during the growing season were collected by an agrometeorological station nearby the growing area, belonging to ARSIAL (cod.RM10SPE) in two years 2020-2021. (Fig. 1 and Fig. 2).

Data were recorded in 2020 and 2021 at different times, according to an international standard BBCH code (Stauss, 1994) a centesimal phenological scale, based on coding system, with some modification due to not well development of the plant (experimental vineyard was set up in 2017). Data were recorded on 50 leaves instead of 100 and on 25 clusters, instead of 50 and used to evaluated incidence as TH index (Townsend and Heuberger, 1943).

Statistical analysis was performed using ARM Software (https://gdmdata.com/products/arm.). The averages of the theses of the different surveys were calculated and compared using the Student's test (p=0.05). Data were analyzed separately for year and for white and red grape varieties.

3. Results and discussion

In 2022 the maximun of leaf infection in withe grapes, as severity and incidence, was showed in Sauvignon Nepis (TH index=1 at BBCH =77) while the other varieties did not show any symptoms on leaves, compared to Trebbiano toscano. For the same group of grapes, infection on bunch was observed in all the varieties but Sauvignon Kretos shows the lower TH index (0,7). Results are reported in Tab. 1.

In red varieties (Tab 2) compared to Sangiovese, downy mildew infection appeared already in BBCH stage code 50, with a TH index of 8.5 in Cabernet Eidos; subsequently this BBCH crop stage code, infection was also observed in Cabernet Volos, with a TH index from 0.75, in BBCH 65-69, to 5.0 in BBCH 77; at the same BBCH stage code infection was detected also in Merlot Kanthus. When the bunch appeared (from BBCH stage code 77) the maximum TH index was assessed in Cabernet Eidos (4.7) and Merlot Khorus (4.0).

In 2021 the situation respect on downy mildew infection on leaves and bunch, is similar in 2020 for cultivars Sauvignon Nepis and S. Kretos, compared to Trebbiano Toscano. Regarding bunch infection in the same year and assessed in all the varieties whit a maximum TH index assessed in S. Nepis at BBCH stage code 79 (Tab. 3).

For red varieties results reported in Tables 4 indicate a similar situation for Cabernet Eidos (TH index= 7,5 at BBCH 79).

In two-years observations, the behavior of these varieties respect *Plasmopora viticola* infection show some interesting aspect. In fact, despite the conditions for the downy mildew inoculum occurred, plants, although with some symptoms, generally show tolerance to the infection, compared to control varieties Trebbiano Toscano, for withe grape. In case of red grapes, TH indexes for Cabernet Eidos variety, both in 2020 and in 2021, are higher than the same indexes for Sangiovese. This aspect could be explained because in some growing area in Italy, cultivar Sangiovese was indicate as moderately to insensitive to

Plasmopora viticola (AA.VV, 2020, 2009) and, in comparison to these varieties, in the Castelli Romani growing area, Sangiovese may not have been the best choice as reference variety.
Differences among tolerant/resistent varieties could also be explain because white varieties usually have a more precocious growth cycle than red varieties, with shoots sprouting and fruit ripening earlier (Boso et al., 2014).

4. Conclusions

These preliminary results have to be confirmed, in fact these are the first results obtained and, certainly, are not exhaustive. The observation of these ten resistant varieties, typical of viticultural of cold environments, must continue in the coming years to assess their agronomic response and their oenological characteristics in the Castelli Romani area, before being entered in the regional register of authorized vines.

5. Acknowledgments

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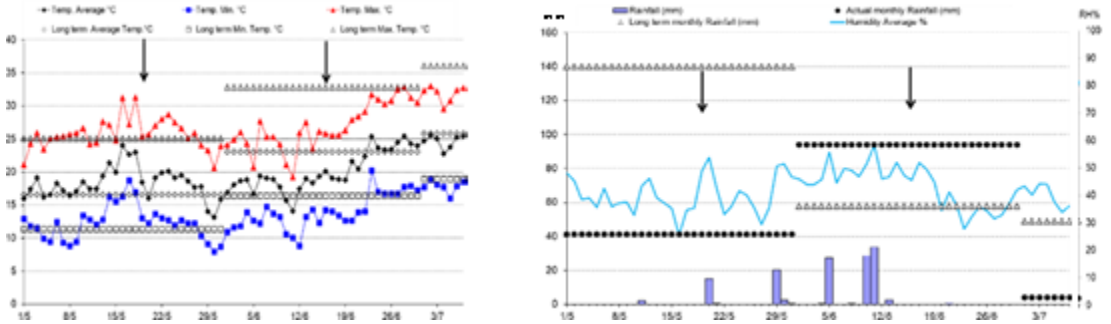

Fig. 1 Temperatures, rains, and humidity in 2020

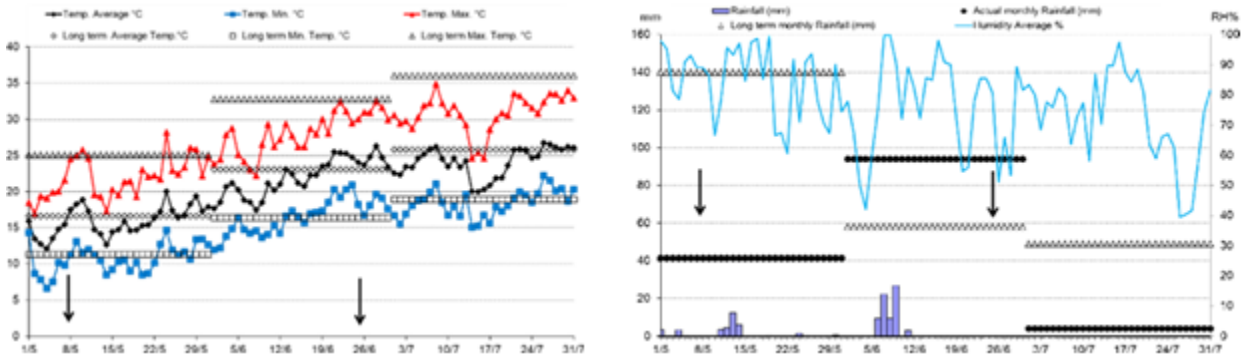

Fig. 2 Temperatures, rains, and humidity in 2021

Table 1. TH index for leaves and bunches in with grape varieties – Year 2020

Cultivars	**TH index (Leaves)**			**TH index (Bunches)**
BBCH code*	55	65-69	77	77
	May, 26	June, 09	July, 07	July, 07
Trebbiano Toscano	0 a	0 a	1.75 a	1.3 abc
Fleurtai	0 a	0 a	0 c	3.0 ab
Soreli	0 a	0 a	0 c	1.3 abc
Sauvignon Kretos	0 a	0.5 a	0 c	2.7 ab
Sauvignon Nepis	0 a	0 a	1.0 b	1.3 abc
Sauvignon Rytos	0 a	0.5 a	0 c	0.7 c

Table 2. TH index for leaves and bunches in red grape varieties – Year 2020

Cultivars	**TH index (leaves)**			**TH index (Bunches)**
BBCH code*	55	65-69	77	77
	May, 26	June, 09	July, 07	July, 07
Cabernet Eidos	8.5 a	3.25 a	3.0 bc	4.7 a
Cabernet Volos	3.5 b	0.75 b	5.0 a	2.3 cd
Merlot Khorus	0 c	0 b	2.25 cd	4.0 ab
Merlot Khantus	0 c	0 b	3.75 b	2.0 cd
Julius	0 c	0 b	1.25 de	2.3 cd
Sangiovese	0 c	0.75 b	3.0 bc	2.0 cd

Table 3. TH index for leaves and bunches in withe grape varieties – Year 2021

Cultivars	**TH index (Leaves)**			**TH index (Bunches)**
BBCH code*	55	65-69	77	77
	May, 26	June, 09	July, 15	July, 15
Trebbiano Toscano	6.50 a	-	7.50 a	16.0 a
Fleurtai	0 b	-	4.25 b	8.0 cd
Soreli	0.25 b	-	0,25 d	9,0 bc
Sauvignon Kretos	5.50 a	-	0,25 d	6.7 cde
Sauvignon Nepis	2.50 b	-	1.75 c	16.0 a
Sauvignon Rytos	0.75 b	-	2,50 bc	9.3 bc

Table 4. TH index for leaves and bunches in red grape varieties – Year 2021

Cultivars	**TH index (Leaves)**			**TH index (Bunches)**
BBCH code*	55	65-69	77	77
	May, 26	June, 09	July, 15	July, 15
Cabernet Eidos	6.50 a	-	7.50 a	16.0 a
Cabernet Volos	0 b	-	4.25 b	8.0 cd
Merlot Khorus	0.25 b	-	0,25 d	9,0 bc
Merlot Khantus	5.50 a	-	0,25 d	6.7 cde
Julius	2.50 b	-	1.75 c	16.0 a
Sangiovese	0.75 b	-	2,50 bc	9.3 bc

55= infiorescence swelling, flowers closely pressed together; 65= full flowering; 69= end of flowering; 77= beginning of berries touch.