

## RESULTS OF THE THREE-YEAR STUDY WITH ADHESIVE PRODUCTS TO INCREASE DEFENSE AGAINST THE GRAPEVINE BLACK ROT ON THE SORELI VARIETY RESISTANT TO DOWNY MILDEW AND POWDERY MILDEW GROWN IN AN ORGANIC SYSTEM

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### ABSTRACT

In the three-year period 2019-2021, a study was conducted in a vineyard located in Risano (Pavia di Udine) in which the variety grown was Soreli, resistant to both downy mildew and powdery mildew. Different products with adhesive capacity were tested, in combination with copper-based treatments, with the aim of supporting the defense against the Black rot. The persistence and durability conferred by the tackifiers has proved to be particularly useful in periods with greater precipitations. The study revealed also that the adhesive products can improve the defense against Black Rot, especially in cases where copper inputs are reduced.

**Key words:** grapevine Black Rot, pinolene, sulphur with tackifiers, suspended sulphur on a terpenic basis, tackifiers.

### 1 INTRODUCTION

The study arises from the need to contain the Black Rot in cases where the quantities of copper are reduced because of the resistance of the grape variety and of the limits that the Reg. (EU) No. 2018/1981 imposed (maximum 28 kg of copper per hectare distributed in 7 years). This is of particular importance when synthetic fungicides cannot be used, as in organic farming. It is known that, on the one hand, the use of varieties resistant to downy mildew and powdery mildew allows a significant reduction in the number of treatments; on the other hand, it is necessary to avoid the appearance of other diseases such as Black Rot, which are normally controlled with treatments done against downy mildew and powdery mildew.

The study was conducted in Risano (UD) in an organic vineyard of the resistant variety named Soreli. In 2017, only after one year from plantation, the first symptoms of the disease were found on the leaves, which increased in 2018, despite the farmer making various treatments with copper-based products with the aim of containing the spread of the disease. Although the aim of the study was the management of Black Rot in a resistant variety grown with organic method, it should be noted that in recent years, in

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Friuli Venezia Giulia and in the northern east regions of Italy, characterized by a wet climate, Black Rot develops endemically (Viala and Ravaz, 2004) with greater frequency and aggressiveness, also in non-organic vineyards. The reason for this could be the recent limitations and revocations of very effective products, such as dithiocarbamates especially mancozeb. (Burrone F., and Pierucci M., 2013)

## 2 MATERIALS AND METHODS

The study was conducted in the three-year period 2019-2021 at an organic vineyard of about 0,3 ha of the resistant variety Soreli. The training method is double Guyot tipped, with planting layout of 1,00 x 2,70 m, irrigated by sprinkling. The vineyard was planted in 2016. During the first year, no phytosanitary treatment was done; in 2017 the first symptoms of the disease were found on leaves and four treatments were carried out with copper-based products for a total intake of 2,4 kg/ha of copper. In 2018 the number of treatments increased to 8, for a total of 3,4 kg/ha of copper. From 2019 to 2021 the company continued its defense by providing the quantities of copper and sulfur indicated in Table 5; to this basic defense (company testimony) we wanted to test in addition 3 different types of tackifiers, 2 of which are sulfur-based and 1 without.

All the products were compared with the control plants, treated only with copper. In literature (Le Roux C., 2015) there are indications on the synergistic effects of sulphur combined with copper in order to contain the Black Rot, so it was decided to have two treatments with sulphur-based adhesives and one without; the addition of adhesives was made according to the rain forecast. The test was carried out on a number of plants equal to 20 per parcel (equal to an area of 55 m<sup>2</sup> per parcel) with an experimental design of 3 replicates randomized blocks on 3 treatment and the control, using a volume of water of 400 L/ha sprayed on the vegetation with a shoulder atomizer model Sthil SR 450. The evaluations were carried out from the appearance of symptoms on clusters. The degree of attack on clusters is measured by an evaluation of diffusion indices (number of clusters affected) and intensity (% of infected berries compared to the total present in the bunch). In addition, the first appearance of symptoms on the leaf and the trend of infections were noted during the 3 years of trial. The obtained data were subjected to the analysis of variance (Anova) and the Tukey-Kramer test at a confidence level of  $P < 0.05$ .

Table 1. Adhesive products applied in 2019, 2020 and 2021 with active substance, application doses and testing year.

Adhesive products applied	Active substance	Application doses (L o Kg/ha)	Testing Year
Nu Film	Pinolene	0,4	2019 <sup>a</sup> , 2020 <sup>b</sup> 2021 <sup>c</sup>
Heliosoufre	Micronized sulphur formulated in suspension concentrated on terpenic basis	5	2019 <sup>a</sup> , 2020 <sup>b</sup> 2021 <sup>c</sup>
Thiopron	Sulphur adhesive	5	2019 <sup>a</sup> , 2020 <sup>b</sup> 2021 <sup>c</sup>

- a) Treatments carried out on 21/6, 4/7, 25/7. Survey on 29 July 2019
- b) Treatments carried out on 29/5, 12/6, 25/6, 7/7. Survey on 22 July 2020
- c) Treatments carried out on 21/6, 6/7, 19/7. Survey on 10 August 2021

### 3 RESULTS AND DISCUSSION

In **2019** the first major rains occurred between April 23 and 26; the period between the end of April and May was characterized by temperatures much below the average, to the point that the development of fungal diseases was slowed down, and high rainfall with several rains even washout ones. On the other hand, June and July were warm and less rainy. After the May rains, there was a significant increase in symptoms for all treatments. In the survey done on June 12 (before starting the test), the first symptoms were detected on leaves (Fig. 1b); in the other inspections the spread on leaf was low and there were no statistically significant differences between the treatments. On the contrary, in the relief of July 29, the spread (76,67%) and the intensity (12,81%) of the disease on the control cluster (Fig. 1a) were high. The 3 tested products, in particular Thiopron, have statistically lowered the intensity of the damage (Table 2). It should be noted that the spread in all the treatments was high, probably for the extent of the inoculum of the previous years.

262



b

Figure 1: Symptoms manifestation on cluster (left) and on leaves (right) on year 2019

Table 2: Spread and intensity of cluster infections in 2019.

Active substance	Spread%	Intensity %
<b>Control</b>	76.67 a	12.81 a
<b>Nu Film</b>	67.11 ab	8,08 b
<b>Heliosoufre</b>	69.11 ab	8.7 b
<b>Thiopron</b>	61.78 b	5.52 c

The year **2020** was characterized by a long dry period (from February to May), with temperatures above average; this has led to a certain devitalization of the spores and an early development of the vine. The most consistent rains have affected the high plain of Friuli while the trial area hasn't been much affected by rainfall. The first significant rains occurred between 23-24 of May and in the first 2 weeks of June there were a series of rainy events, often washout ones, that subsequently led to a certain increase of infections especially on clusters; the first symptoms were detected from late June onwards. The spread of the disease on leaves has always been less than 1% without significant differences between treatments. In the survey carried out on July 22 (Table 3) the infection on the control cluster was of average intensity (6,46%) and in any case significantly lower than the previous year. This is probably due to the late start of infections and advanced development of the vine as well as for the treatments carried out by the farmer (Table 5); the spread rate was on average high (35,33%). There has been a significant reduction in the spread of cluster's symptoms and in the intensity of the damage for all treatment.

Table 3: Spread and intensity of cluster infections in 2020.

Active substance	Spread%	Intensity %
<b>Control</b>	35,33 a	6,46 a
<b>Nu Film</b>	16,67 b	0,74 b
<b>Heliosoufre</b>	11,11 c	1,4 b
<b>Thiopron</b>	13,56 bc	1,55 b

The year **2021** was characterized by a particularly rainy May with 21 days of significant rainfall and temperatures, especially the highs, which were significantly lower than the average of the last 10 years (this led to a start of primary infections which remained mostly latent until the onset of warm). The months of June and July were characterized by low rainfall and by temperatures higher than average. The first symptoms on leaves were found on May 26; the dry and warm period of June and July slowed the development of the disease on leaves while from the end of June the symptomatology affected the clusters more. By the results (Table 4), it's evident that the 3 treatments carried out with adhesives fell in a slightly rainy period and the only treatment that

anticipated a major rain was that of July 6. This explains a less marked response from the adhesives products on the containment of the symptoms of the disease on clusters. However, in the last survey, on August 10, all 3 products were statistically improved compared to the control.

Table 4: Spread and intensity of cluster infections in 2021.

Active substance	Spread %	Intensity %
<b>Control</b>	42,44 a	7,75 a
<b>Nu Film</b>	34,22 ab	3,22 b
<b>Heliosoufre</b>	27,11 b	3,93 b
<b>Thiopron</b>	27,33 b	3 b

#### 4 CONCLUSIONS

During the trial, it was decided to limit the quantities of copper per hectare (Table 5) despite the current Black Rot infections and the favourable weather and environmental conditions for the development of the disease, accepting also the risk of a partial loss of production.

264

Table 5: Quantities of copper and sulphur distributed by the farmer per year.

Year	Copper (Kg/ha)	Total sulphur (Kg/ha) in the control and in treatment with Nu Film	Total sulphur (Kg/ha) in the treatments with Heliosoufre and with Thiopron
<b>2019</b>	3,4	26,35	41,35
<b>2020</b>	3,99	19,31	39,31
<b>2021</b>	3,64	21,34	46,34

Following the tests carried out, there were significant differences in terms of damage on the cluster after the application of the different adhesives tested in addition to the normal copper treatments done by the farmer. The addition of adhesives both with and without sulphur has played a synergistic action determining in all years a significant difference compared to the control treated with only copper. The presence or absence of sulphur in the adhesive hasn't led to a significant reduction of the damage, but this can be justified by the fact that the farmer had already treated with consistent quantities of sulphur (Table 5). However, Thiopron showed a good performance (statistically different also compared to the other adhesives) in 2019, a year characterized by the greatest disease pressure and a higher spread and intensity of the fungus on the control. The spread on leaf has always been low and this can be due both to factors linked to varietal characteristics and to the copper and sulphur treatments carried out by the farmer, in particular in May and June in order to keep the inoculum low. After all, it is known that leaf and cluster infections can occur independently and have very different

dynamics. Black Rot is a fungal disease and, if not properly treated, can persist for several years in the vineyard. The use of products with sticking properties, especially in conditions of high disease pressure, should not preclude the scrupulous defence with copper-based products, as well as all agronomic practices aimed at containing the inoculum (collection and removal of mummified bunches and infected pruning residues, aeration of the foliage and uprooting of abandoned neighbouring vineyards).

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