GRAPE BLACK ROT (*GUIGNARDIA BIDWELLII*), AN INCREASED THREAT IN OSTROV - OLTINA VINE GROWING AREA

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Abstract: Grapes growing is an ancient tradition throughout Romania. This process presents significant challenges due to plant pathogens, requiring specialization and informed skill from local viticulturists. Increasing climate change is raising new challenges for plant protection in vineyards so that black rot of grapes has begun to develop yearly more and more incidence. This paper highlights the importance and the special role of an effective disease control in vineyards in the southern area of Dobrogea in order to obtain a quantitatively and qualitatively increased yield. An eleven years study on black rot development in two grape varieties (Italia and Muscat Ottonel) signaled an increasing incidence of this disease. Contact and systemic fungicide treatment schemes were applied at two local farmers in 2024 in the area. The results of efficacy trials, based on the assessment of both foliage and bunches, showed a final range of 65% to 76.7%.In control plots (untreated), grape yield decreased significantly by 71-73% and was of low quality. Consequently, the development of innovative and more effective control strategies will be essential for future pathogen management.
Keywords: *black rot, control, treatments, incidence, efficacy*

INTRODUCTION

The grapevine is one of the world's oldest cultivated plants and the world's most widespread fruit plant throughout all continents, excepting Antarctica (Dejeu, 2006; Dejeu 2010). Viticulture is also a highly diversified sector, a key source of agricultural income for many regions and a significant part of agricultural yield. It has been considered since ancient times as an element of civilization, characteristic of many advanced peoples.

Grapevine growing is an important branch in the agricultural economy of many countries and Romania is one of them, with a cultivated area of 164 thousand ha and a production of 886 thousand tons in 2023. The importance of this crop also lies in the fact that it can make use of soil and climatic resources unfit to other agricultural crops, obtaining significant yields per hectare for fresh consumption or for wine production. Due to the favourable environmental conditions, there are areas specialized in the production of table grapes and wine, too, in which a large number of pests and pathogens are very destructive (Dejeu, 2010), causing major, often irreparable, damage. The ascomycete *Guignardia bidwellii* (Ellis) Viala & Ravaz (anamorph: *Phyllosticta ampelicida* (Englem.) var der Aa), can cause crop losses between 5 and 80% while in severely affected vineyards, even 100% (Onesti et al., 2016). Varieties of *Vitis vinifera* Linnaeus compared to wild *Vitis* species are more affected by environmental factors such as biotic stress (damage caused by fungi, insects, viruses, bacteria etc.) and abiotic stress (e.g. temperature, heavy metals, salinity etc.) which can lead to significantly lower yields.

In recent times there has been an increasing incidence of black rot (*G. bidwellii*) in Europe and implicitly in Romania, possibly caused by global warming but also by changes in cultivation technology over time. Other causes could be the major increase in the areas cultivated with inter- and intraspecific varieties resistant to powdery mildew and downy mildew but very susceptible to black rot, the withdrawal of some active ingredients in plant protection and the growth of abandoned or poorly tended vineyards. The disease is originated in North America, from where it spread to Europe through exported grapevine planting nursery material (first reported 1885). The disease manifests itself on leaves and petioles, shoots and bunches (Alexandri et al., 1972; Hoffman et al., 2004) and can cause total crop losses in plantations located in warm and humid climates. The attack is most common on old, basal leaves (fig. 8), by circular, reddish-bounded, grayish spots (Zală, 2014; Bettinelli et al., 2023) from where it passes onto the bunches. The fungus has no particular requirements for growth, which is favored by long periods of rainfall in spring with air humidity above 85%. Optimum temperatures are between 22-28°C (Ullrich et al., 2009). The fungus overwinters mainly in decaying, fallen attacked leaves on the ground and in lesions or affected areas on the arms. Spring rains trigger the formation of ascospores from pycnidia which are carried by the wind and cause new infections (Harms et al., 2005; Ferri & Ramsdell, 1978). Rotted and infected pods from bunches left on the soil surface after harvesting produce ascospores which may infect the leaf mass from bud break until 2 weeks after flowering. On the bunches, disease progression is very fast so that, from the first symptoms visible until the browning of berries it could pass only 2-3 days (Alexandri et al., 1972). The rotted part softens and becomes sunken. The infected berries easily loose water, shrivel and wilt, getting a wrinkled look (fig. 9) very easy to be recognised. If there is no infection on the leaves, bunches are not usually attacked afterwards.

This fungus is propagated both in the perfect stage, as perithecia, and as pycnidia with macroconidia on affected organs (Alexandri et al., 1972). As black rot spreads only under humid weather conditions, the lack of water inhibit spores' dismemberment and their dispersion (Molitor & Beyer, 2014).

Considering these issues, this paper aims to present aspects of black rot control of grapevine in the Southern Dobrogea area, where this pathogen continues to cause damage every year.

MATERIALS AND METHODS

The research was conducted between October 2023 and September 2024 in two grapes farms located in Gârlița village and Canlia village, both in South Western Constanța county which belong to Ostrov-Oltina vine growing area. A hand-pruned vineyard planted in 2006 at 2.5 x 1.2 meters with table grapes variety Italia, grafted on SO 4 VCR 105 and trained in double Guyot system, was chosen for study at Gârlița in a section where black rot had developed regularly (Figure 2). At Canlia, another vineyard consisting of Muscat Ottonel variety, was taken into account (Figure 4). These vines grafted on Kober 5 BB and trained on spurred - cordon were planted in 2009 at 2 x 1 meters. Repeated mechanical hedge-pruning during growing season at this farm created vines with large, very dense canopies. The nonselective nature of this pruning technique, and a consistent history of severe black rot development, led to retention of many mummies within the trellis year after year that keeps the inoculum source for next year. The trial was conducted using the randomized complete blocks method in four repetitions. Experimental plot treated with fungicides consisted of 100 vines while the untreated control plot had 60 plants. 10-11 phytosanitary treatments were carried out by the farmers, scheduled according to the vine critical stages, from BBCH 00 (Dormancy) to BBCH 95 (leaf fall). The two treatment schemes (Table 1 and 2) with contact and systemic fungicides were applied by tractor Goldoni 442 (Figure 5) together with towed atomizer of Agri Ionica.

100 leaves and 50 bunches per vine were assessed before each spray and after ten days until the latest treatment by visually rating. The last assessement was at harvest on bunches. Assessments were made on the frequency (F, %, or Pest Incidence) and the intensity (I, % or Pest Severity) of pathogen attack and the degree of attack (DA, %) and efficacy (E, %) were calculated. The degree of attack was calculated using the formula: DA% = F% x I%/100. The efficacy of fungicides was calculated according to Abbott`s formula: (degree of attack in untreated control - degree of attack in treated plot)/ degree of attack in untreated control x 100. All data were subjected to statistical analysis provided by ARM-9 (P= .05 Student Newman Keuls sofware (Jalobă et al., 2021). At harvest time, the yield/vine was weighed using a professional scale. During the vegetative rest period, autumn tillage was carried out by ploughing on the intervals between rows. Pruning works for growth and bearing control were carried out in early spring, before the beginning of the growing season. Prunned branches were chopped by a shreder. The grass between the rows was mowed three times during the growing season by an orchard rotary roller mower. Weeds between the vines on rows were hoed by an in-row hoeing blade cultivator. Specific cultural practices for vineyards were performed including tasks done by hand (shoot, bud and leaf canopy management), maintenance, fertilization, irrigation and pest control. A quantity of 1200 liters/m^2 (Gârlița) and 800 liters/m^2 respectively (Canlia) of water was applied by drip irrigation to the vineyards from april until july.

Italia (or 65 Pirovano) is table grape variety obtained in 1911 by professor Angelo Pirovano by crossbreeding Bicane with Muscat de Hambourg. It has a very strong vigor and a semi-erect bearing so that it must be trained and pruned long. Italia variety belongs to late-season grape maturity (Dejeu, 2010) and in southern Romania it ripens in the beginning of sepetember (Figure 1). The bunches are very large, conical-shaped, moderately compact with large to very large berries (Ion et al., 2018). The skins are moderately thick with a firm and juicy pulp and the berries have a pleasant flavor. Thick skin is covered with white bloom. The 'Italia' grape is resilient to winter cold (Anastasiei et al., 1989) but susceptible to diseases, especially to downy mildew and grey rot.

Muscat Ottonel is a white wine grape variety (Figure 3) that was obtained by Mr Moreau-Robert in the 19th century from the crossbreeding between Chasselas and Muscat d’Eisenstadt (or Muscat Ingram as others say). It is intended for making dessert and odorous, aromatic or dry wines but also for human consumption as table grape. This variety has medium to weak vigor of growth, and very high fertility, over 85% fertile seedlings (Ranca et al., 2012). Muscat Ottonel has a productivity that ranges between 7-15 tons per hectare (Glăman et al., 2018) depending on the area and the applied agro-techniques and can accumulate large quantities of sugars (200-280 g/l).

Figure 1. Italia variety

Figure 2. Gârlița vineyard

Figure 3. Muscat Ottonel var.

The bunches are small, 80-100 g, white in color and cylindrical in shape. The berries are small to medium sized, round, a slightly yellowish shade of green color, with a coppery blush on the sunny side. The pulp is crunchy, juicy, with a thick skin (Giugea & Mărăcineanu, 2005). It has a good tolerance to frost (-20 to 22˚C), less resistant to drought, sensitive to downy mildew and powdery mildew, medium resistant to grey rot, sensitive to grape moth attack, especially in the south of the country and in drier areas.

Table 1. Treatments programme in Gârlița

Tr. No.	Product	Active substance	Conc. a.s. (g/kg, g/l)	Formu lation	Dose (kg,l/ha)	Pathogen	Applic. time (BBCH), Month, decade
1	**Bouillie Bordelaise type MIF** **Sulfomat 80 PU**	Copper from Bordeaux mix Sulphur	200 800	WDG WP	10	*Plasmopara viticola* *Uncinula necator*	BBCH 91 (After harvest, end of wood maturation), Oct. II
2	**Bouillie Bordelaise type MIF**	Copper from Bordeaux mix	200	WDG	10	*Plasmopara viticola*	BBCH 97 (End of leaf fall), Nov. I
3	**Bouillie Bordelaise type MIF**	Copper from Bordeaux mix	200	WDG	10	*Plasmopara viticola*	BBCH 00 (Dormancy), Febr. II
4	**Bouillie Bordelaise type MIF**	Copper from Bordeaux mix	200	WDG	10	*Plasmopara viticola*	BBCH 03 (End of bud swelling: buds swollen but not green), March II
5	**Bouillie Bordelaise type MIF** **Polisulf**	Copper from Bordeaux mix S (15%) + Ca (4%) + C (2%	200 210	WP SL	10 20	*Plasmopara viticola* *Uncinula necator*	BBCH 07 (Beginning of bud burst: green shoot tips just visible), Apr. I
6	**Karathane Gold 350 EC** **Spirox D** **Vertimec 1,8 EC**	Meptildinocap Spiroxamine + difenoconazole Abamectin	350 450 18	EC EC EC	0,5 0,5 0,8	*Uncinula necator* *Guignardia bidwellii,* *Pseudopeziza tracheiphila,* *Plasmopara viticola* *Tetranychus urticae*	BBCH 15 (5th leaves unfolded), Apr. III
7	**Sercadis** **Profiler 71,1 WG** **Mospilan 20 SP** **Calbit C**	Fluxapiroxad Fluopicolide + Fosetyl-Al Acetamiprid Calcium complexed with LSA	300 711 200 435	SC WG SP L	0,15 2,50 0.25 4	*Uncinula necator* *Plasmopara viticola* *Lobesia botrana* Stimulator	BBCH 57 (Inflorescences fully developed, flowers separating), May I
8	**Airone SC** **Spirox D** **Pyrus 400** **Coragen**	Copper Spiroxamine + difenoconazole Pyrimethanil Chlorantraniliprol	272 450 400 200	SC EC SC SC	2,5 0,5 1,5 0,175	*Guignardia bidwellii,* *Pseudopeziza tracheiphila,* *Plasmopara viticola* Idem *Botrytis cinerea* *Lobesia botrana, Eupoecilia ambiguella*	BBCH 69 (End of flowering), May III
9	**Mikal Flash** **Vivando** **Cantus** **Vertimec 1,8 EC**	Fosetyl-Al + folpet Metrafenona Boscalid Abamectin	750 500 500 18	WG SC WG EC	3 0,2 1 0,8	*Plasmopara viticola* *Uncinula necator* *Botrytis cinerea* *Tetranychus urticae*	BBCH 77 (Berries beginning to touch), June. II
10	**Airone SC** **Spirox D** **Decis 25 WG** **Switch 62,5 WG**	Copper Spiroxamine + difenoconazole Deltametrin Cyprodinil + Fludioxonil	272 450 250 500	SC EC WG WG	2,5 0,5 0,03 0,8	*Guignardia bidwellii,* *Pseudopeziza tracheiphila,* *Plasmopara viticola* Idem *Lobesia botrana, Eupoecilia ambiguella* *Botrytis cinerea*	BBCH 79 (Majority of berries touching), July II
11	**Switch 62,5 WG**	Cyprodinil + Fludioxonil	500	WG	0,8	*Botrytis cinerea*	BBCH 81 (Beginning of ripening: berries begin to develop variety - specific colour), Aug. III

Table 2. Treatments programme in Canlia

Tr. No.	Product	Active substance	Conc. a.s. (g/kg, g/l)	Formu lation	Dose (kg,l/ha)	Pathogen	Applic. time (BBCH), Month, decade
1	**Bouillie Bordelaise type MIF**	Copper from Bordeaux mix	200	WDG	10	*Plasmopara viticola*	BBCH 95 (50% of leaves fallen), Nov. I
2	**Champ 77 WG**	Metallic copper	770	WG	2	*Plasmopara viticola*	BBCH 00 (Dormancy), Febr. II
3	**Folpan 80 WDG** **Microthiol Special** **Vertab** **Aminoplant**	Folpet Sulphur Abamectin Nutrients, essential aminoacids	800 800 18 912	WG WG EC LC	2 3 0.8 3	*Plasmopara viticola* *Uncinula necator* *Tetranychus urticae* Climatic Stress	BBCH 13 (3 leaves unfolded), Apr. II
4	**Folpan 80 WDG** **Microthiol Special** **Vertab** **Aminoplant** **Spirox D** **Cyperguard 25 EC**	Folpet Sulphur Abamectin Nutrients, Essential aminoacids Spiroxamine + difenoconazole Cipermetrin	800 800 18 912 450 250	WG WG EC LC EC EC	2 3 0.8 3 0,5 0,2	*Plasmopara viticola* *Uncinula necator* *Tetranychus urticae* Climatic Stress *Guignardia bidwellii,* *Pseudopeziza tracheiphila,* *Plasmopara viticola* *Lobesia botrana*	BBCH 55 (Inflorescences swelling, flowers closely pressed together), Apr. III
5	**Domark 10** **Thiovit Jet 80 WG** **Forum Gold** **Aminoplant** **Evobor**	Tetraconazol Sulphur Dimetomorf + dithianon Nutrients, Essential aminoacids Bor	100 800 500 912 110	EC WG WG LC LC	0,250 5 1,5 3 1	*Uncinula necator* *Uncinula necator* *Plasmopara viticola* Climatic Stress Deficiency	BBCH 69 (End of flowering), May II
6	**Zorvec Zelavin** **Microthiol Special** **IKAR** **Coragen**	Oxathiapiprolin Sulphur NNO3 + Microelements Chlorantraniliprole	100 800 320 200	EC WG LC SC	0,5 3 0,5 0,175	*Plasmopara viticola* *Uncinula necator* Deficiency *Lobesia botrana,* *Eupoecilia ambiguella*	BBCH 73 (Berries groat – sized, bunches begin to hang), June II
7	**Sercadis** **Zorvec Zelavin** **Thiovit Jet 80 WG** **Aminoplant** **Pyrus 400** **Cyperguard 25 EC**	Fluxapiroxad Oxathiapiprolin Sulphur Nutrients,Essential aminoacids Pyrimethanil Cipermetrin	300 100 800 912 400 250	SC EC WG LC SC EC	0,15 0,5 3 3 1,5 0,2	*Uncinula necator* *Plasmopara viticola* *Uncinula necator* Climatic Stress *Botrytis cinerea* *Lobesia botrana*	BBCH 77 (Berries beginning to touch), June III
8	**Airone SC** **Thiovit Jet 80 WG**	Copper Sulphur	272 800	SC WG	2,5 3	*Guignardia bidwellii,* *Pseudopeziza tracheiphila,* *Plasmopara viticola* *Uncinula necator*	BBCH 79 (Majority of berries touching), July II
9	**Karathane Gold 350 EC** **Airone SC**	Meptildinocap Copper	350 272	EC SC	0,5 2,5	*Uncinula necator* *Guignardia bidwellii,* *Pseudopeziza tracheiphila,* *Plasmopara viticola*	BBCH 79 ((Majority of berries touching), July III
10	**Switch 62,5 WG** **Topas 100 EC**	Cyprodinil + Fludioxonil Penconazole	500 100	WG EC	0,8 0,4	*Botrytis cinerea* *Uncinula necator*	BBCH 81 (Beginning of ripening: berries begin to develop variety - specific colour), Aug. II

Figure 4. Canlia vineyard

Figure 5. Tractor Goldoni 442

RESULTS AND DISCUSSIONS

A. Degree of attack (DA%)

As this is an area of great viticultural potential, pathogens are carefully monitored by farmers who assess the level of attacks by compiling and recording annual databases of each pathogen and pest. While the usual problems for wine growers have usually been related to downy mildew, powdery mildew and grey rot, lately black rot, both on leaves and bunches, has been on the rise and increasingly threatening. The cooperating farmers at this study had *Guignardia bidwelli* degree of attack% record sheets from 11 years ago in their farms.

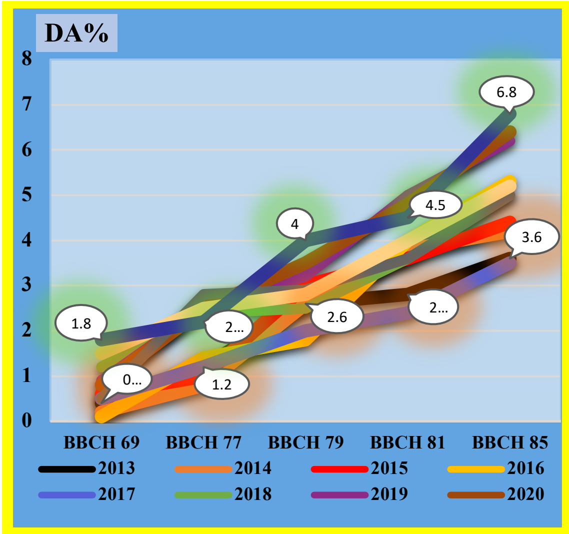

Figure 6. Degree of atack% on leaves at Gârlița
P-value= 0.0064 < 0.05 (Anova); $LSD_{0.05}$=1,105

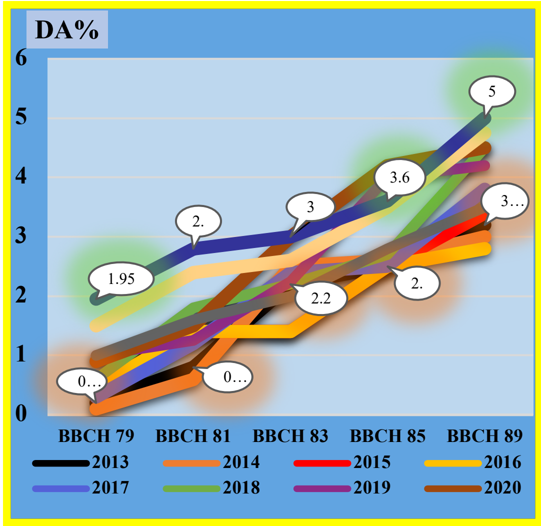

Figure 7. Degree of atack% on bunches at Gârlița
P-value= 0.003< 0.05 (Anova); $LSD_{0,05}$=0,860

For the leaf infection, which usually starts in May, it can be noted that DA% has had an increasing trend every year in Gârlița, not being eradicated or even stopped by the treatments applied by farmers to the table grape variety Italia. Year after year an increase in DA% has been observed both at the onset of infection and especially towards the end of the growing season. If in 2013 there was a development from 0.4% to 3.6%, in 2023 it went from 1.8% at the end of flowering to 6.8% in the beginning of ripening stage (fig. 6). On bunches, the attack has a similar evolution, increasing from 0.2% (BBCH 79) to 3.2% (BBCH 89) in 2013, to reach 5% (BBCH 89) in 2023 (fig. 7), up from 1.95% (BBCH 79). One could say that there has been a serious increase in the level of attack during these eleven years of assessment.

Figure 8. Symptoms on leaves at Gârlița

Figure 9. Symptoms on bunches at Gârlița

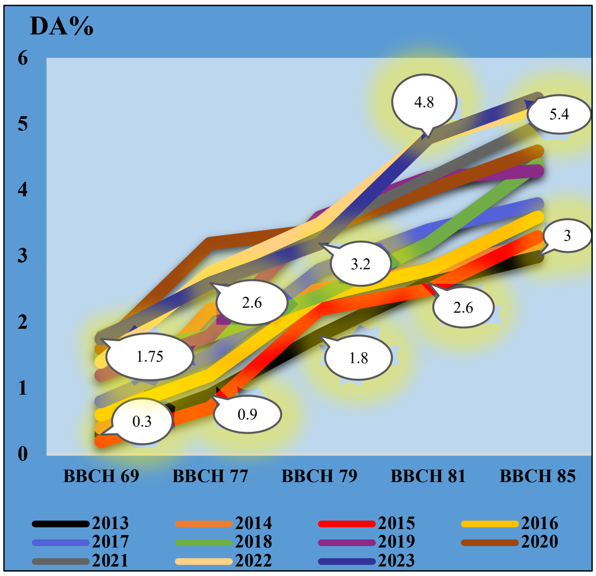

Figure 10. Degree of atack% on leaves, Canlia
P-value= 0.00847 < 0.05 (Anova); $LSD_{0.05}$=1,022

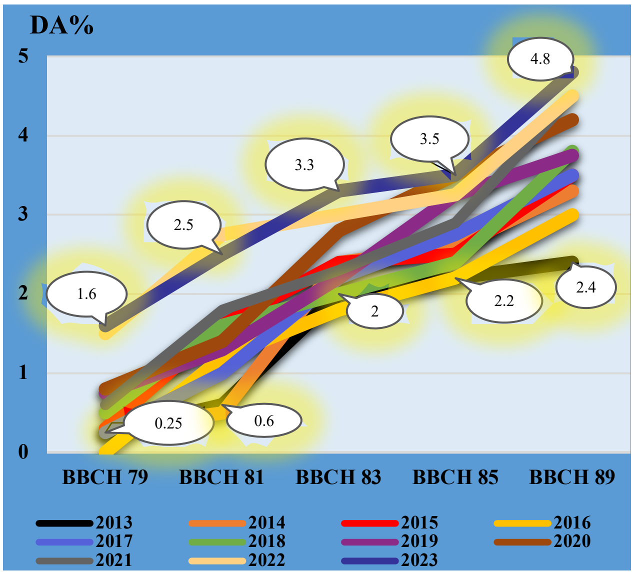

Figure. 11. Degree of atack% on bunches, Canlia
P-value= 0.0013 < 0.05 (Anova); $LSD_{0.05}$=0,784

Likewise, on the vineyard in Canlia, the Muscat Ottonel grape variety had a DA% on leaves of 0.3% at the end of flowering in 2013, which reached 3% when the grapes were in the ripening stage. Infection increased both phenophase by phenophase and year by year. Thus, in 2023, black rot attack of grapevine evolved from 1.75% recorded at the end of flowering to 5.4% (fig. 10) at BBCH 85.

Similarly, the infection transmitted from leaves to berries showed a progressive evolution from the bunch compaction phenophase, when most berries are touching (BBCH 79), to the full ripening stage (BBCH 89). As a result, if in 2013 an ascending infection was noted from 0.25% to 2.4%, in 2023 it reached 4.8% (fig. 11) when the grapes were ready to harvest. Local farmers have noted with concern that a pathogen that posed very little problem in the past is becoming a potential hazard year on year for their vineyards, in addition to the other threats already present.

Evolution of the pathogen *G. bidwellii* in 2024 in the two vineyards and efficacy of chemical treatments.

The symptoms of black rot are most noticeable as the first leaves mature at the base of the shoots (where the infection most often occurs), which is most often synchronized with the end of flowering growth stage (BBCH 69). Small, 2-3 millimeter, sparse, prominent, at first dark-grayish then purple-brick reddish spots can be seen on the leaves. The pathogen then can also affect bunches, since the berries are susceptible to attack throughout the whole growing period until maturity.

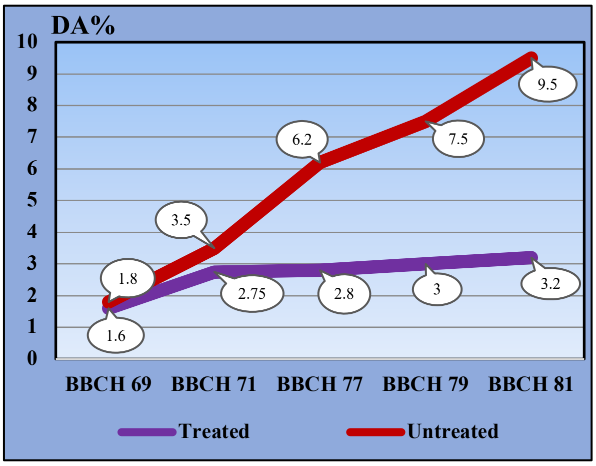

Figure 12. Attack of black rot on leaves, Gârlița
P-value= 0.063 > 0.05 (Anova); $LSD_{0.05}$=3.24

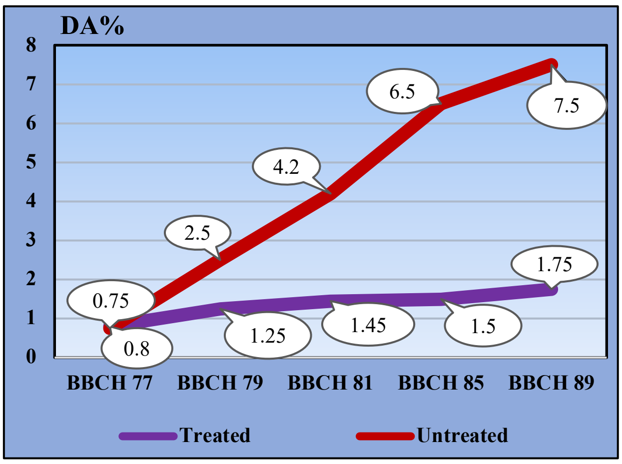

Figure 13. Attack of black rot on bunches, Gârlița
P-value= 0.047 < 0.05 (Anova); $LSD_{0.05}$=2,89

Evolution of black rot on leaves in the two vineyards assessed in 2024 growing season is shown in figure 12 and figure 13 (at Gârlița) and in figure 14 and figure 15 (at Canlia).

In the Gârlița vineyard, in May, at the end of flowering, DA% on leaves in the treated and untreated areas had approximately equal values: 1.6% and 1.8% respectively. Following the schedule of applied treatments, it evolved differently and at the end of the assessments it reached 3.2% in the treated variant and 9.5% in the untreated control where no phytosanitary treatments were applied.

On bunches, at the beginning of the observations, a DA% of 0.75% was recorded in the untreated control and 0.8% in the plot subjected to phytosanitary treatments. At BBCH 89 (grapes ready to be harvested), a DA% of 7.5% was registered in the untreated plot, while in the treated plot it was 1.75%.

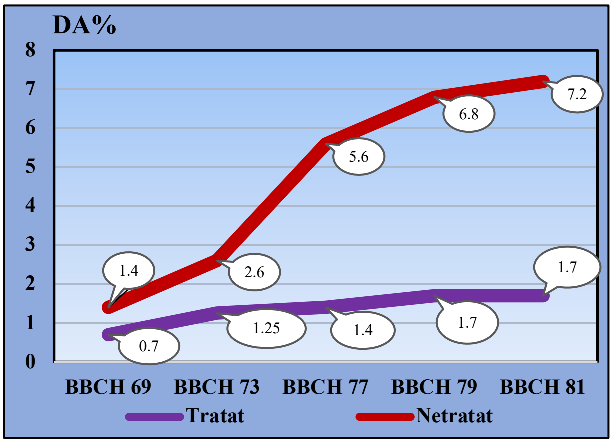

Figure 14. Attack of black rot on leaves, Canlia
P-value= 0.026 < 0.05 (Anova); $LSD_{0.05}$=2.701

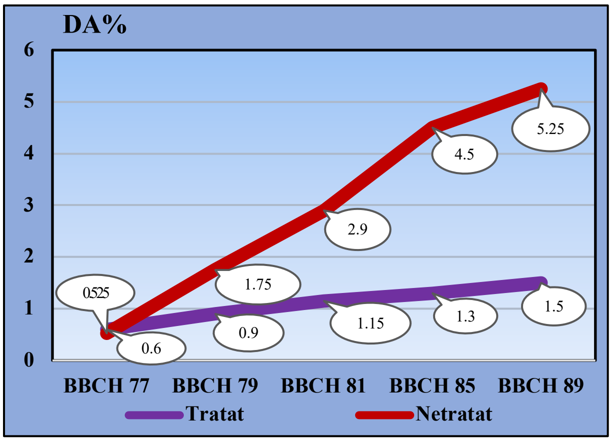

Figure 15. Attack of black rot on bunches, Canlia
P-value= 0.0635 > 0.05 (Anova); $LSD_{0,05}$=2.03

Black rot infection also occurs in grapewine varieties, distorting the production and therefore the quality of the wine. In the Muscat Ottonel variety at Canlia, observations made at the end of flowering revealed a DA% on the leaves of 0.7% in the treated plot and 1.4% in untreated plot. Under the conditions provided by drip irrigation (800 liters/m^2 per growing season) and the specific environment, it was observed an increase of DA% up to 7.2% (fig. 14) on leaves at the beginning of ripening stage. In the treated plot it did not exceed 1.7%.

The attack on Muscat Ottonel bunches resulted in an increase in infection from 0.6 to 1.5% during the pathogen development until full ripening in the treated sample, whereas the untreated control showed a DA% of 5.25% (fig. 15) at the technological maturity stage. Initially, it was 0.625%. This made a large proportion of the bunches unfit for commercialization.

It should be noted that in the treated plot the DA% was limited by the treatments carried out, but not totally stopped. Despite farmers' efforts, it seems that a certain amount of inoculum remained in the vineyard which may become a source of infection for next growing season.

B. Efficacy (E%)

Vineyards are the areas of agriculture with the highest used of applied pesticides due to its specialization and intensification who made this sector more and more susceptible to pests and diseases outbursts as well as to climate change effects. The use of Plant Protection Products, in precise quantities and moments, may allow to protect the vineyard efficaciously and efficiently with a limited environmental impact.

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In these two vineyards, we performed disease assessments according to the degree of attack (DA%). This value represented the extent of the attack of black rot on the vines reported by the total number of plants on which the observations were made; results after calculating the frequency of the attack F% and the intensity of the attack I% (Hnatiuc et al., 2023). Comparing the results of DA% between treated and untreated plots, we registered the efficacy of the treatments after each application. The data is presented in Fig. 16 and Fig. 17.

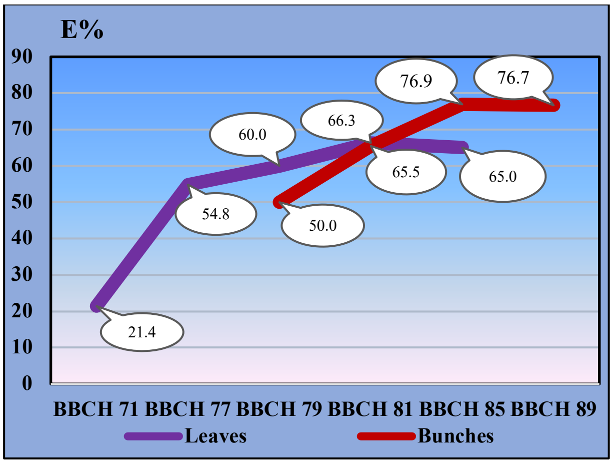

Figure 16. Efficacy against black rot on Italia
$LSD_{0.05}$=25.80

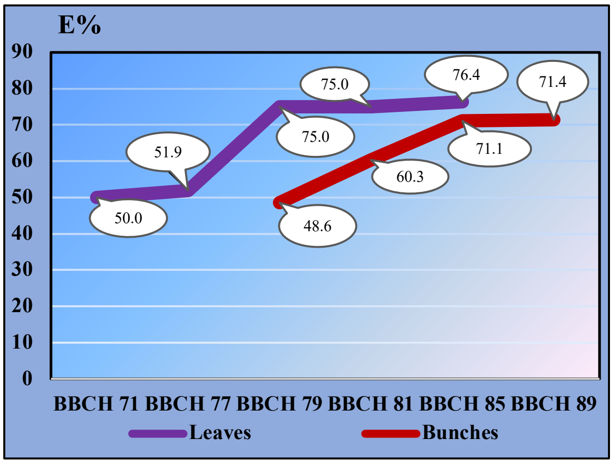

Fig. 17. Efficacy against black rot on M. Ottonel
$LSD_{0.05}$=19.66

Plant protection treatments are (still) an indispensable tool for pathogen control. Under the given conditions, each individual treatment contributed to stopping or substantially reducing the DA% of the various diseases that usually harm the vines in South Dobroudja. But as it can be seen, black rot attack could not be stopped and could not even be controlled to at least 80% level. In our case, the efficacy % of fungicide treatments showed an upward trend, alongside the increase in DA% in the untreated sample. In the case of black rot, a final efficacy % evaluated on leaves and bunches between 65 and 76.7% was obtained, distributed as follows: At Gârlița, table grape variety Italia, 65% on leaves, 76.7% (fig. 16) on bunches; at Canlia, variety Muscat Ottonel, 76.4% for leaves, 71.4% (fig. 17) for bunches. Altogether, these results weren`t as good as farmers` expectation especially because of the threatening of imminent pathogen propagation in the next growing season. There has also been a deterioration in the quality and quantity of production, which has displeased farmers. Yield values are shown in Figure 18.

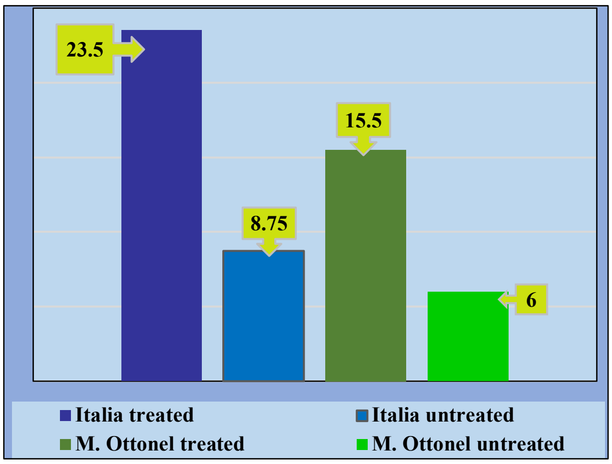

Figure 18. Grape yield (t/ha)
P-value=0.00826 < 0.05 (Anova). $LSD_{0.05}$=2.759

Figure 19. Muscat Ottonel variety at harvest

CONCLUSIONS

A scheduled application of phytosanitary treatments in critical phenophases, at warning, has led to a substantial reduction (but not eradication) of black rot infection. For the commercial finished product (bunches), stopping the attack is of utmost importance in order to increase the marketability of the grapes (Italy) (fig. 21) and to optimize the winemaking process for Muscat Ottonel (fig. 20). At this point in time, application of fungicides is the primary tactic used to control black rot in most commercial vineyards, although sanitation (i.e., removing infected debris from the trellis or the vineyard altogether) and good canopy management can augment the efficacy of these sprays.

In the untreated control, the pathogen *G. bidwellii* caused both a reduction in the functional leaf area and, consequently, a weakening of the vines and a decrease of the quantity and quality of grape production.

It is of the utmost importance for farmers to correctly assess the growth stages of vines at the same time as the critical periods requiring phytosanitary intervention. The successful management of black rot must involve a combination of sanitation practices aimed at reducing the amount of inoculum and at using judiciously the fungicides. Recommended agro-phyto-technical measures: watersprouts weeding, suckers and unuseful shoots cutting to avoid excessive humidity, defoliation of leaves in the cluster zone, harvesting grapes earlier in wet and warm autumns; extinguishing infection outbreaks. Phytosanitary treatments with specific products to control this pathogen at key moments are of great importance. Treatments to control downy mildew and other diseases do not protect against black rot.Due to the increasing impact of this pathogen, further study is required in the future in order to find new innovative control methods and management practices.

Figure 19. Muscat Ottonel yield for local markets

Figure 20. Muscat Ottonel yield for wine making

Figure 21. Italia variety at harvest

Figure 22. M. Ottonel yield for human consumption

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