

## SUMMARY

of the doctoral thesis entitled:

# RESEARCH ON PLUME DISEASES AND THEIR CONTROL IN ȘOIMARI LOCATION, PRAHOVA COUNTY

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Climate change and the progress made in recent years in plum culture technology have motivated research on the health status of plum orchards, with special attention on some key pathogens as *Polystigma rubrum* that causes red spotting of plum leaves, *Wilsonomyces carpophilus* (syn. *Stigmina carpophila*) responsible for the occurrence of mycotic leaf spotting, moniliosis - caused by *Monilinia* spp., of which *M. laxa* is the most common.

Considering the economic importance of the plum in the agriculture of the countries that allow this culture and the multiple requirements on the market for the consumption of plum fruits, the researches on specific diseases of the plum such as the red spotting of the leaves and on some diseases characteristic of stone trees such as moniliosis and mycotic rot require permanent attention for fundamental and applied agricultural research.

The pathogens *Wilsonomyces carpophilus* (syn. *Stigmina carpophila*) and *M. laxa* appear year after year in plum crops and have a major impact on fruit production from a qualitative and quantitative point of view. In addition, their presence depreciates the health of the trees, requiring phytosanitary interventions to prolong the life of the trees.

Also, the *Polystigma rubrum* fungus, increasingly common in the context of climate change, causes premature defoliation of trees, delaying vegetation and having a negative impact on production.

Knowing the requirements regarding plum culture and the impact of pathogens on fruit production through the research topic of the doctoral thesis I did research on the most frequent plum diseases in the research area, under the aspect of the evolution

of the attack during the analyzed period, the effectiveness of the applied treatment scheme, the identification by classical microscopy methods of the *Monilinia* species detected in culture.

The purpose of the doctoral thesis was to carry out research on the behavior of some foreign plum genotypes and a romanian genotype to the attack of the main pathogens with an impact on production, monitoring the effectiveness of the proposed treatment scheme. The research was carried out in the period 2017-2019 under the conditions of the Șoimari location, Prahova county.

Objectives:

- Presentation of the clinical picture of the analyzed diseases;
- microscopic identification of the pathogens analyzed;
- carrying out biometric measurements of confirmed pathogens;
- identification based on the morphological characteristics of the fruits of the species *Monilinia laxa*;
- carrying out in vitro research on the biological parameters of the fungus *Monilinia laxa* (light, culture media, temperature);
- monitoring the attack of *Monilinia laxa*, *Polystigma rubrum* and *Wilsonomyces carpophilus* (*Stigmina carpophila*) agents in the genotypes studied;
- determinations on the frequency, intensity and degree of attack in the case of monitored diseases;
- realization of an integrated treatment scheme for detected diseases;
- calculating the effectiveness of the scheme applied in combating the detected and researched diseases;
- the influence of the treatment on the productions obtained;
- achieving the correlation of moniliosis attack on fruits and production;
- statistical analysis of the obtained results;

The experiments were located within the plum orchard of the research location and highlighted the main pathogens faced by the plum culture in an area recognized for plum culture and the development of an integrated scheme to take into account the presence of major plum pathogens and which can be made available to growers in the area. The *in vivo* research was completed with sensitive laboratory analyzes to contribute to the correct diagnosis of the pathogens involved in the symptoms of the detected diseases. Research on the biological parameters of a key pathogen of the plum such as *Monilinia laxa* contributes to the taking of measures in agricultural practice (fertilization, timing of application of phytosanitary interventions) to stop the evolution of the attack of the pathogen in the crop. We consider that our research thus presents a scientific and applied character that completes the knowledge regarding plum pathology and brings novel contributions regarding the reaction of the genotypes to the attack of the monitored pathogens, the preparation of a pathogen control scheme that also integrated products to have an effect on their potential vectors, biometric measurements and biological parameters. Also, research on the *Polystigma rubrum*

pathogen brings this pathogen up to date, whose impact has increased in the context of climate change, through aggressiveness and virulence.

The doctoral thesis is structured in two parts: the first part includes the bibliographic study on the researched topic and the second part in which the own researches are presented.

Part I of the thesis includes a bibliographic study about the diseases and pathogens responsible for their production in plum.

Chapter I, entitled "*The current state of knowledge of the main diseases of the plum*" summarizes the scientific information regarding the main pathogens of the plum, making a complete presentation of the most important ones in the category of pathogenic viruses, bacteria, fungi. Notions about the manifestation of diseases, systematics of pathogens, ecology, epidemiology and their control are presented.

The second part of the thesis, entitled "*Own research*" presents the purpose, the aim and the objectives of the work, then in separate chapters it presents the conditions for conducting the research, the material and the working method, the calculation formulas used, the statistical analysis of the data, the research carried out under conditions *in vivo* and *in vitro* to the monitored pathogens, general conclusions and recommendations.

Chapter II, *The natural framework and climatic conditions specific to the research period*, after the presentation of the proposed goal and for the achievement of which targets were established from the beginning of the experimental activity, presents the climatic and pedological conditions of the research area, with an emphasis on meteorological conditions in the experimental area, during 2017-2019.

Chapter III, *Material and working methods*, contains information on the research methods used in the macroscopic and microscopic diagnosis of the monitored pathogens, calculation formulas suitable for the research used in determining the frequency, intensity and degree of attack, the organization of the experiences, the effectiveness of the treatments provided in the control scheme proposed for experimentation, as well as the analyzed genotypes. Also, the pathogen identification method, the biological material for sampling and the proper identification with the device and software used and the identification by the classic method of the *M laxa* species and the *in vitro* biological parameters of this micromycete are presented. The statistical calculation method used is also presented.

Chapter IV, *Results and discussions*, includes the results obtained after making observations in field and laboratory conditions.

Research on the manifestation of monitored diseases, red spotting of leaves, mycotic leaf spotting and moniliosis was carried out on the basis of concrete, original observations accompanied by original figures from the experimental field, which complete the clinical picture of the described pathology.

Research on the attack of the pathogens *Polystigma rubrum*, *Stigmina carpophila* and *Monilinia laxa* monitored the attack every year, 2017, 2018, and 2019, and

highlighted the frequency and intensity of the attack on the attacked organs, based on which the degree of attack was calculated. Thus, in 2017, in the untreated version, the attack of the two pathogens had an incidence of 100% on the leaves, for all analyzed genotypes, Stanley, Anna Spath and Gras românesc. The intensity of the attack made the difference between the genotypes, in the case of the Stanley variety the intensity of the *Polystigma rubrum* pathogen attack was 29%, in the Anna Spath variety it had an intensity value of 22.5%, and the Gras românesc variety had the lowest value of the intensity of the attack, of 19.5%. The *Wilsonomyces carpophilus* attack was 38% in the Stanley variety, 34% in the Anna Spath variety and 30.5% in the Gras românesc variety.

The moniliosis attack on the shoots had an incidence of 15% in the Stanley variety, 18% in the Anna Spath variety and 11% in the Gras românesc variety. Since the shoots had a complete browning, covering the organelle entirely, the intensity was considered 100%. Regarding the attack on fruits, higher frequency values were noted, such that they were 32% in the Stanley variety, 33% in the Anna Spath variety and 29.5% in the Gras românesc variety. The value of the intensity of the attack was considered maximum, because the fruits were completely covered in a short time, being unfit for use. In the experimental year 2017, an integrated treatment scheme was applied, which included fungicides and insecticides approved and recommended at the time to combat monitored pathogens.

The results regarding the influence of the treatment scheme, in the case of the pathogen *Polystigma rubrum*, showed that compared to the control variant, the value of the degree of attack was reduced for all genotypes monitored in the treated variants, by decreasing the values of the intensity of the attack. Thus, in the Stanley variety, the intensity had values of 9.5%, compared to the control with 29%, and in the case of the Anna Spath variety, the intensity reached 7.5%, in the treated version. In the Gras românesc variety, the attack of red spot was reduced from 19.5% in the control variant to 6% after applying the treatments provided in the presented scheme.

Research on the influence of treatments from the proposed scheme on the attack of moniliosis on shoots and fruits reduced the attack, respectively its incidence in the treated variants compared to the control variants, in 2017. In the Stanley variety, the frequency of moniliosis attack on shoots was reduced to 5.5% compared to the control, where F=15% and on fruits at 11% compared to 36% in the control. In the case of the Anna Spath variety, the attack frequency on the shoots was 7% after the treatments and on the fruits 13% compared to the untreated variants, where the incidence was 18% and 38%, respectively. The data regarding the attack of moniliosis in the Gras românesc variety showed that the attack of the pathogen on the shoots decreased to 3.5% compared to the control with F=11% and on the fruits a frequency of 9% was recorded after the application of the treatments, compared to the variant untreated with F=33%.

The data obtained in 2018 show that in the untreated version the attack of micromycetes was determined by a maximum frequency in all varieties but with different intensity values: in the Stanley variety the attack of the *Polystigma rubrum*

fungus recorded an average intensity value of 31% and the attack of *Stigmata carpophila* of 36%. In the Anna Spath variety, the intensity was 28% for *Polystigma rubrum* and 31.5% for *Wilsonomyces carpophilus*, and in the case of the Gras românesc variety, intensity values of 21.5% for red spot attack and 30% for leaf spotting were noted. The attack of moniliosis on shoots and fruits in 2018 in the untreated version recorded a decrease in the frequency of the attack, the intensity being noted as 100%, the shoots being removed and the diseased fruits being unsuitable for their use for various purposes. In the Stanley variety, a frequency value of 14% on the shoots and 32% on the fruits was determined, and in the Anna Spath variety, the incidence of the attack on the shoots was 16% and on the fruits 33%. In the case of the Gras românesc variety, the attack value on shoots was 9.5% and on fruits 30%. The application of the treatments decreased the attack in the treated varieties, in the Stanley variety the red spot attack had an average intensity value of 9%, compared to the control with I=31% and in the Anna Spath variety an intensity value of 8.5% was recorded compared to of 28% in the control. In the case of the Gras românesc variety, the attack of the *Polystigma rubrum* fungus on the leaves was 6.5%, the lowest among the analyzed varieties. Regarding the attack of leaf spotting, it was found that also in the Gras românesc variety, the intensity value was the lowest at 8.5%, compared to the control with a value of 30%. For the Stanley and Anna Spath varieties, attack intensity values on leaves of 10.5% (Stanley) and 9.5% (Anna Spath) were determined compared to the higher values of the control variants.

In the conditions of 2019, the presence of pathogens on the leaves was 100% and the intensity also gave the value of the degree of attack in the control variant. The intensity of the *Polystigma rubrum* attack on the leaves of the three varieties was 30% in the Stanley variety, 25.2% in the Anna Spath variety and 20.5% in the Gras românesc variety. The attack of the *Wilsonomyces carpophilus* micromycete on the leaves recorded intensity values 37% for the Stanley variety, 32.7% for the Anna Spath variety and 30.1% for the Gras românesc variety. the level of moniliosis attack on shoots and on fruits in the control version in 2019, so that in the Stanley variety the attack on shoots had a frequency value of 17% and on fruits of 32.5%. The attack of the pathogen in the case of the Anna Spath variety on shoots registered a frequency value of 16.5% and on fruits of 33%. Regarding the attack of moniliosis in the Gras românesc variety, a frequency value of 10% on leaves and 29.5% on fruits was determined. Also, the results obtained after the application of the treatments decreased the attack of the analyzed pathogens. Following the application of the treatments from the analyzed scheme, the effectiveness was calculated and it was found that it had more than 60% effectiveness in combating the analyzed diseases in the researched varieties. The highest efficiency values were determined for the Stanley and Gras românesc varieties. The products included in the treatment scheme ensured the protection of the varieties in the experimental conditions, during the research period. The highest value of the

effectiveness of the treatment scheme on the attack of moniliosis on fruits in 2019 was recorded for the Gras românesc variety of 75%.

The research on the influence of the treatment on the production highlighted both the role of the treatment scheme and the genetic potential of the monitored varieties. This was highlighted by analyzing the interaction of the productions obtained in the plum crop under the influence of the applied treatments (Factor A) and the cultivated variety (Factor B). The analysis of the data on the productions obtained in the plum crop under the influence of the applied treatments (Factor B) and the cultivated variety (Factor B) in the pedoclimatic conditions of the research location in 2017 found that: the influence of factor A the plum variety. The influence of the variety factor on the obtained productions, it is found that the obtained productions varied between a minimum value of 9927.5 kg/ha in the Gras românesc variety and a maximum value of 11115 kg/ha in the Stanley variety. Compared to the Gras românesc variety considered as a control, the other two varieties have increases in production of 1187.5 kg/ha for the Stanley variety and 2532.5 kg/ha for the Anna Spath variety. The influence of factor B applied treatment; The influence of factor B applied treatment determined the production of 9668.3 kg/ha in the untreated version and 12666.7 kg/ha in the treated version. The increase in production obtained by applying the treatments was 2998.4 kg/ha, being statistically assured as very significant Influence of Factor A at the same graduation of factor B (AxB). The influence of factor A the variety on the productions obtained in the plum crop for the same treatment (Factor B) it is found that: for the untreated variants the production obtained was 8855 kg/ha in the case of the Gras românesc variety considered as control and a maximum value of 10920kg/ha for the Anna Spath variety of 10920 kg, respectively 9230 kg/ha for the Stanley variety. Compared to the Gras românesc variety considered as a control, the other two varieties have increases in production of 1187.5 kg/ha for the Stanley variety and 2532.5 kg/ha for the Anna Spath variety. The influence of factor B applied treatment; The influence of factor B applied treatment determined the production of 9668.3 kg/ha in the untreated version and 12666.7 kg/ha in the treated version. The increase in production obtained by applying the treatments was 2998.4 kg/ha, being statistically assured as very significant Influence of Factor A at the same graduation of factor B (AxB). The influence of factor A the variety on the productions obtained in the plum crop for the same treatment (Factor B) it is found that: for the untreated variants the production obtained was 8855 kg/ha in the case of the Gras românesc variety considered as control and a maximum value of 10920kg/ha for the Anna Spath variety of 10920 kg, respectively 9230 kg/ha for the Stanley variety. Compared to the Gras românesc variety, the Anna Spath variety recorded a production increase of 2065 kg/ha and the Stanley variety an insignificant increase of 375 kg/ha: for the treated variants the production obtained varied between 11000 kg/ha the Gras românesc variety considered as control and a maximum value of 14000 kg/ha for the Anna Spath variety, respectively 13000 kg/ha for the Stanley variety. Compared to the Gras românesc variety, the Anna Spath variety recorded a

production increase of 2000 kg/ha and the Stanley variety a sport of 3000 kg/ha, both very significant. Influence of Factor B at the same graduation of factor A (BxA). The influence of the treatment applied to the plum crop (Factor B) on the productions obtained for the same variety (Factor A) shows that for the Stanley variety the production increased from 9230 kg/ha in the untreated version to 13000 kg/ha in the treated version with a very significant of 1187.5 kg/ha. For the Anna Spath variety, production varied between 10920 kg/ha in the variant without treatments and 14000 kg/ha in the variant to which treatments were applied to combat diseases and pests, obtaining an increase in production of 3,080 kg/ha, statistically assured as very significant. For the Gras românesc variety the damaged production between 8855 kg/ha in the variant without treatments and 11000 kg/ha in the case of applying the treatments with a very significant increase in production of 2145 kg/ha.

In the conditions of 2018, the influence of the variety factor A on the obtained productions, it is found that the obtained productions varied between a minimum value of 8032.5 kg/ha for the Gras românesc variety and a maximum value of 9460 kg/ha for the Anna Spath variety. Compared to the Gras românesc variety considered as a control, the other two varieties have increases in production of 1417.5 kg/ha for the Stanley variety and 1427.5 kg/ha for the Anna Spath variety.

The influence of the factor B applied treatment. The influence of the factor B the application of the treatment determined the production of 7295 kg/ha in the untreated version and 10000 kg/ha in the treated version. The increase in production obtained by applying the treatments was 2705 kg/ha, being statistically ensured as very significant in the influence of Factor A at the same graduation of factor B (AxB). It is found that: for the untreated variants the production obtained was 7065 kg/ha in the case of the Gras românesc variety considered as control and a maximum value of 7920 kg/ha in the Anna Spath variety, respectively 6900 kg/ha in the Stanley variety. Compared to the variety Gras românesc, the Anna Spath variety recorded a significant increase in production of 855 kg/ha, and the Stanley variety a non-negative increase of 165 kg/ha; for the treated variants the production obtained varied between 9000 kg/ha the Gras românesc variety considered a witness and a maximum value of 11000 kg/ha in the Anna Spath variety, respectively 10000 kg/ha in the Stanley variety. Compared to the Gras românesc variety, the Anna Spath variety recorded a production increase of 1000 kg/ha and the Stanley variety a sport of 2000 kg/ha, both very significant. Influence of Factor B at the same graduation of factor A (BxA). Influence of treatment applied to the plum culture (Factor B) on the productions obtained for the same variety (Factor A) it is found that for the Stanley variety the production increased from 6900 kg/ha in the untreated version to 10000 kg/ha in the treated version with a very significant increase of 3100 kg/ha. For the Anna Spath variety, production varied between 7920 kg/ha in the variant without treatments and 11000 kg/ha in the variant to which treatments were applied to combat diseases and pests, obtaining an increase in production of 3080 kg/ha, the statistics ensured as very significant. For the Gras românesc variety the production



varied between 7065 kg/ha in the variant without treatments and 9000 kg/ha in the case of applying the treatments with a very significant increase in production of 1935 kg/ha.

In 2019, the influence of factor A the variety of plum. The influence of the variety factor on the obtained productions, it is found that the obtained productions varied between a minimum value of 8975 kg/ha for the Stanley variety and a maximum value of 11537.5 kg/ha for the Anna Spath variety. Compared to the Gras românesc variety considered as a control, the other two varieties have increases in production of 375 kg/ha for the Stanley variety and 2562.5 kg/ha for the Anna Spath variety. The influence of factor B applied treatment. The influence of factor B applied treatment determined the production of 8575 kg/ha in the untreated version and 11333.3 kg/ha in the treated version. The increase in production obtained by applying the treatments was 2758.3 kg/ha, being statistically assured as very significant. The influence of Factor A at the same graduation of factor B (AxB). The influence of factor A the variety on the productions obtained in the plum crop for the same treatment (Factor B) it is found that: for the untreated variants the production obtained varied between 7700 kg/ha in the case of the Stanley variety and a maximum value of 10075 kg/ha in the Anna Spath variety, respectively 7950 kg/ha for the Gras românesc variety considered as a control. Compared to the Gras românesc variety, the Anna Spath variety recorded a very significant increase in production of 2125 kg/ha, and the Stanley variety a negative sport of 250 kg/ha: for the treated variants the production obtained varied between 10000 kg/ha for the Gras românesc variety considered a witness and a maximum value of 13000 kg/ha in the Anna Spath variety, respectively 11000 kg/ha in the Stanley variety. Compared to the Gras românesc variety, the Anna Spath variety recorded a production increase of 1000 kg/ha and the Stanley variety a sport of 3000 kg/ha, both very significant. Influence of Factor B at the same graduation of factor A (BxA). Influence of treatment applied to the plum culture (Factor B) on the productions obtained for the same variety (Factor A) it is found that for the Stanley variety the production increased from 7700 kg/ha in the untreated version to 11000 kg/ha in the treated variant with a very significant increase of 3300 kg/ha. For the Anna Spath variety, production varied between 10075 kg/ha in the variant without treatments and 13000 kg/ha in the variant to which treatments were applied to combat diseases and pests, obtaining an increase in production of 2925 kg/ha, statistically assured as very significant. For the Gras românesc variety, the production varied between 7950 kg/ha in the variant without treatments and 10000 kg/ha in the case of applying the treatments with a very significant increase in production of 2050 kg/ha.

The research in laboratory conditions highlighted the correct identification of diseases through laboratory analyzes of the pathogens involved, by performing biometric measures that confirmed the pathogen-disease relationship, cause and effect. Measurements of the identification fruits were made and the standard deviation was calculated. Research in the laboratory continued to establish the biological parameters



of the pathogen *M. laxa* and it was found that the pathogen prefers PDA and PMA culture media and develops a rich vegetative mass at the alternation of 24/24 hours and 12h/12h light/darkness. The fungus developed well at a temperature of 20-24°C, considered the optimal biological threshold.

Chapter V presents the general conclusions and recommendations formulated as a result of the research carried out.

The thesis includes 148 pages with 27 tables from which 25 originals and 50 figures from which 39 originals. The bibliography cites 160 references from specialized literature and web sources.