INDICATORI PENTRU DIAGNOZA TIMPURIE ȘI CUANTIFICAREA STRESSULUI BIOECENOTIC LA UNELE SPECII POMICOLE CULTIVATE ÎN SISTEM SUPERINTENSIV

INDICATORS FOR EARLY DIAGNOSIS AND QUANTIFICATION OF BIOECENOTIC STRESS ON SOME FRUIT SPECIES GROWN IN THE SUPERINTENSIVE SYSTEM

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Abstract

The diversity of the soils and the climatic conditions and their variations, are very favorable for a wide range of pests and diseases, of the fruit tree species, which can generate significant economic losses. In the context of annual climate changes, there is a need for integrated interdisciplinary research and for the choice of indicators for early diagnosis of the level of biocenotic stress to which the modern orchards grown under superintensive system are subjected. The responses of the trees to the biocenotic stress are dynamic, as the intensity of the response increases with the increase of the stress level. The main factors on which depend the plants adaptation to biocenotic stress are: the species, age, group of varieties, the main pests and pathogens present in the cultivation area. The paper presents results obtained at RIFG Pitesti-Maracineni during 2017-2019, regarding the choice and use of synthetic indicators for early diagnosis of the biocenotic stress level, to which modern orchards are subjected. The adults flight dynamics (sum and average of catches and the economic damage threshold EDT) for the harmful *Hymenoptera* and *micro-Lepidoptera*, on cherry, plum, peach and apple, grown under superintensive system, as well as the risk of infections with fungal pathogens under conditions were investigated. Also, it was assessed the speed of fruits contamination with mycotic pathogens, specific for storage spaces, at some apple varieties with perspectives for expansion into commercial farms.

Cuvinte cheie: pomi, stress biocenotic, indicatori, diagnoza timpurie.

Key words: trees, biocenotic stress, indicators, early diagnosis.

1. Introduction

In Romania fruit growing is an important branch of the agriculture sector, a traditional activity of the people living in countryside area and important source of incomes as well. The fruit growing area is located mainly on hilly regions, inside and outside the Carpathian Mountains, on wide range of soils and climatic conditions. In order to obtain high quality fruits, use of performant cultivars, of innovative cultivation techniques and phytoprotection strategies, represent the success key components of production chain in the modern superintensive orchards (Amzăr, 1999; Biggs et al. 1998, Brun et al. 2005, Șerboiu et al. 2001, Teodorescu et al. 2000, 2001, 2003, 2006, Tomșa, 2003). In the context of actual climate changes (Chiemlewski et al., 2004, 2005), there is a need for integrated interdisciplinary research on the influence of microclimate changes. A rapid diagnosis real-time warning and quantification of potential losing caused by biocenotic stress registered in superintensive orchards is strongly felt. The responses of the trees to the biocenotic stress are dynamic, as the intensity of the response increases with the increase in the stress level. The main factors on which depend the plants adaptation to biocenotic stress are: the age, species, group of varieties, the main pests and pathogens existing in the cultivation area (Drosu, 2001 Rădulescu, 1972, Steiner, 2000, Spotts, 1990, Teodorescu, Tomsa, 2003) and therefore is vital to find indicators for early diagnosis and quantification of the biocenotic stress and to know the varieties response, prior to their extent in superintensive orchards. This is the main objective of this paper.

2. Material and methods

The researches were conducted between 2017 and 2019 at RIFG Pitesti. The experimental module organized is complex and consists in: a) 1 plot of cherry, established in 2017, the trees were planted at a distance of 4.0 m between rows and 1.0 m between trees in the row (density D = 2,500 trees / ha) and driven as a spindle, with individual support system and fertigation installation; b) 1 plot of peach

established in spring 2010, planted at a distance of 4 m between rows and 3.0 m between trees in the row (density $D = 833$ trees/ha); c) 1 plot of plum, set up in the spring of 2009, at the planting distance of 4.0×2.25 m (density $D = 1,111$ trees / ha), on the Saint Julien low vigor rootstock and d) 1 plot of apple, which was established in spring of 2016, at the planting distance of 3.0×1.0 m; density $D = 3,333$ trees / ha on the M 9 rootstock, with trees driven in the form of a thin axis. The experimental device was located on a plain terrain, placed on the second terrace of the Arges River, on a low to medium fertile alluvial clay soil unit (more than 30% of clay; humus less than 1.7%; nitrogen index 0.33-1.43; PAL 1.3-2.5 mg/100g, but well supplied with potassium, up to 40 mg/100 g). Soil reaction is slightly acid ($pH=5.8-6.8$). The orchard floor was covered with grass between the tree rows and cleared with total herbicides, on stripes of 1.0-1.2 m wide, along the tree rows. Each experimental plot received the right amount of nutrients by fertirrigation according to each species needs, the key pest and diseases were monitored constantly especially in the untreated control variants (check).

The weather conditions were monitored with a set of sensors and recorders, mounted on WatchDog platforms provided by Spectrum, USA and iMetos from Pessl Austria, equipped with expert software.

The key pest flight dynamic and pressure were monitored with pheromones traps, AtraCERAS, AtraLIN, AtraMOL, AtraFUN, AtraPOM, produced at the Research Institute for Chemistry 'Raluca Ripan' from Cluj-Napoca and with the real time monitoring system TrapView, produced in Slovenia.

The key pathogens pressure was assessed based on attack risk charts, attack frequency ($F\%$) and intensity (I 1--6notes) and were calculated damages degree ($DD\%$), varietal sensitivity index ($VSI\%$) according the formula's: $DD\% = (F\% \times I) / 100$ and $VSI\% = DD_1\% + DD_2\% + \dots DD_n\%$.

In the case of the apples, the fruits obtained in superintensive orchards were stored in conventional cool warehouse and then they were assessed in the lab, regarding the damages degrees produced both by physiological disorders and diseases caused by specific fungi.

All the experimental data were stored, processed and analyzed using the facilities of and Specware Pro 9.0 and iMetos software and MS Office Excel 2010 facilities.

In order to be easy handled, the results charts were also optimized, using the free software Irfan View 4.25 and Photofiltre 7.0.2.

3. Results and discussions

Results on microclimate monitoring

Assessment of the Fig. 1 (microclimate conditions climadiagram), reveals that at RIFG Pitesti and within surrounding area, during the latest 50 years, the annual rainfall excess occurs from October until March and it was 130 mm. As regard the annual rainfall deficit, it grows up to 146 mm and stretches out from April till September. The tables 1 through 3 present the dynamics and means of the climate variables used here.

In 2017, the coldest month was January with a minimum temperature of -21.7°C (the average -4.9°C) and the hottest month was August with whit the maximum temperature of $+37.5^\circ\text{C}$ (the average $+21.7^\circ\text{C}$).

The leaves wet period ranged from 169 hours/month in May up to 110 hours/month in September.

The rainiest months were May and July with 153.4 and 109.0 mm and the driest month was September with 19.0 mm. Also, the total precipitation amount was 755 mm.

In 2018, the coldest month was March with a minimum temperature of -19.8°C (the average $+3.9^\circ\text{C}$) and the hottest month was August, with the maximum temperature of $+33.9^\circ\text{C}$ (the average $+22.2^\circ\text{C}$).

The leaves wet period ranged from 130 hours/month in May up to 184 hours/month in August.

The rainiest months were May and June with 112.5 and 198 mm and the driest month was October with 2.0 mm/m^2 . The total precipitation amount was 746 mm.

Also, in 2019 were oscillatory microclimate conditions. The coldest month was January, with a minimum temperature of -13.5°C (the average -1.2°C) and the hottest month was August with the maximum temperature of 35.1°C (the average 22.8°C).

The leaves wet period ranged from 107 hours/month in May to 135 hours/month in July.

The rainiest months were July with 197.1 and August with 93.1 mm and the driest month was August with 9.7 mm. Also, the total precipitation amount was 520 mm.

A close examination of the tables 1-3 highlights that, during the study period (2017-2019), the monthly average values of the weather variables were very favorable to the key pest and diseases attack on the studied fruit species.

A. Results on pest monitoring and pest attack (biotic stress) on modern superintensive orchards

On cherry trees, fruits fly (*Rhagoletis cerasi* L.) is the most important pest of the cherry orchards.

During 2018-2019, the adult's flight was lasting between 20 May and 14 June, the maximum flight was registered between 3-9 June with a peak of 12 adults / trap / week.

In untreated cherry plots, the most affected was 'Kordia/Weiroot-2' variety (F%= 76.50; DD%=2.30), and the less affected was the 'Sweetheart/Gisela 12' variety (F% = 42.00%; DD%=1.26).

In the case of bud weevil (*Sciaphobus squalidus*), the most affected was 'Kordia/Weiroot-2' variety (F%=4.89; DD%=0.15), and the less affected were 'Skeena/Gisela-5' and 'Lapins/Gisela-6' varieties (F%=2.89; DD%=0.09 and F%=2.93; DD%=0.09).

As regard the leaf roller (*Opheroptera brumata*) attack, the most affected was 'Skeena/Gisela-5' (F%=10.95; DD%=0.33) and the less affected was 'Lapins/Gisela-6' (F%=3.73; DD%=0.07).

In the case of black aphid (*Mysus cerasi*), the most affected was 'Lapins/Gisela-6' (F%=42.00; DD%=1.68) and the less affected was 'Sweetheart/Gisela 12' variety (F% = 4.51%; DD%=0.09).

However, on some varieties, the bud weevil, leaf roller and black aphid attacks were under economic damage threshold (EDT).

Based on the collected data in Table 4, using varietal sensitivity index (VSI%), a classification of the cherry varieties was done, regarding their behavior to the biotic stress, caused by the key pests as follow: 'Lapins/Gisela-6' (VSI%=3.79); 'Kordia/Weiroot-2' (VSI%=2.83); 'Fervia/Gisela-5' (VSI%=2.48); 'Daria/IPC' (VSI%=2.23); 'Skeena/Gisela-5' (VSI%=2.05); 'Sweetheart/Gisela-12' (VSI%=1.56).

On peach trees, fruits moth (*Cydia molesta*) is the most damaging pest of the peach orchards. During 2018-2019, the adult's flight was monitored between 01 May and 30 August. The maximum flight was registered in the mid of May (G1), with a peak of 22 adults/trap/week, which exceed 7.3 times the economic damages threshold (EDT). In the case of the following generations (G2 and G3), the flight was quite low after the fruits harvest and exceeds with only 1.00-1.66 the economic damages threshold (EDT).

In untreated peach plots, the most affected by the peach moth (*Cydia molesta*) attack was the 'Redhaven/Adaptabil' variety (F%=23.60, DD%=1.18), followed by 'Jerseyland/Adaptabil' (F%=27.40; DD%=1.10), which were also damaged by the green aphid - *Mysus cerasi* (F%=32.50; DD%=1.95) respectively (F%=25.32; DD=0.51).

Based on the collected data in Table 5, using varietal sensitivity index (VSI%), a ranking of the studied peach varieties was done, regarding their behavior to the biotic stress caused by the key pests as follow: 'Redheaven/Adaptabil' variety (VSI%=3.91); 'Jerseyland/Adaptabil' (VSI%=2.27), followed by 'Filip/Adaptabil' (VSI%=2.30).

On plum trees, fruits moth (*Cydia funebrana*) is the most important pest of the plum orchards. Assessments of the figure 4 reveal that the adults flight last during 1 May until 20 August. The maximum flight was registered in the mid of May (G1), with a peak of 22 adults/trap/week, which exceeded 7.3 times the economic damages threshold (EDT). For the second generation of the pest (G2) the peak was registered in the first decade of July, which exceeded 7.33 times the economic damages threshold (EDT).

In the untreated plum plots, at harvest time, the most affected variety was 'Cacanska Rodna/Saint Julien' (F%=38.66; DD%=1.93) and the less affected was 'Andreea/Adaptabil' (F%=27.55; DD%=1.38). In the case of the stone wasp (*Eurytoma schreinerii*) attack, the most affected variety was 'Andreea/Adaptabil' (F%=75.00; DD%=4.50), but the less affected was 'Stanley/mirobolan' (F%=57.00; DD%=2.28). As regard the leaf rollers attack the most affected variety was 'Carpatin/Saint Julien' (F%=17.60; DD=0.53) and the less affected was 'Andreea/Adaptabil' (F%=12.30; DD%=0.37). The aphids (*Hyalopterus pruni*) also preferred the 'Andreea/Adaptabil' (F%=32.10; DD%=1.28), but the less affected variety was 'Centenar/Saint Julien'.

Based on the data organized in the Table 6, using varietal sensitivity index (VSI%), a classification of the studied plum varieties was done, regarding their behavior to the biotic stress caused by the key pests as follow: 'Andreea/Adaptabil' (VSI%=7.57), 'Cacanska Rodna/Saint Julien' (VSI=6.20), 'Carpatin/Saint Julien' (VSI%=5.71), 'Centenar/Saint Julien' (VSI%=5.57), 'Stanley/Mirobolan' (VSI%=4.49).

A close examination of the Fig. 5 reveals that apple codling moth remain the most dangerous pest of the apple orchards. During 2018-2019, the adults flight last during 1 May till 30 August and after.

The maximum flight was registered in the mid of May (G1), with a peak of 26 adults/trap/week, which exceeded 6.5 times the economic damages threshold (EDT). For the second generation of the pest (G2) the peak was registered in the second decade of July (19.06) which exceeded 7.33 times the economic damages threshold (EDT). From 06 to 30 August, the apple codling moth flight was decreasing from 11.0 till 2.0 adults/trap/week.

On apple trees, during 2018-2019, in the untreated plot, the first generation of apple codling moth (*Cydia pomonella*) strike harder 'Jonagold de Costa/M9' clone (F%=22.25; DD%=0.89) and lesser 'Goldrush/M9' variety (F%=25.00; DD%=0.50).

As regard the second generation of the pest, strike harder 'Jonagold Boerenkamp/M9' clone (F%=18.10; DD%=1.09) and lesser 'Goldrush/M9' variety (F%=14.00; DD%=0.70).

During the study period, the attack of other key pests the superintensive apple orchard was under the economic damages threshold (EDT).

B. Results on disease monitoring and disease attack (biotic stress) on modern superintensive orchards

Using the expert software of the Pessl platforms, the risks of the key pathogens attack in superintensive orchard were assessed.

On cherry trees, due the weather conditions registered in the first parts of the vegetation periods, the microclimate conditions were favorable for shoot hole (*Stigmia carpophila*) and the brown rot (*Monilia* spp.), the attack lasted from 11 April to 12 August and during 6-9 September. The attack risk ranged in many periods between 25-90% for shoot hole and 20-25 up to 100% for brown rot (see Fig.6).

Under orchard conditions, the attack of the key pathogens in the untreated plot of cherry, confirmed the predicted risk.

In the case of the anthracnose (*Blumeriella jaapi*), the most affected were 'Lapins/Gisela-6' and 'Skeena/Gisela-5' varieties (F%=34.10; DD%=1.36) and (F%=33.95; DD%=1.36) and the less affected was 'Sweetheart/Gisela-12' (F%=5.70; DD%=0.11).

In the case of the shoot hole (*Stigmia carpophila*), the most attacked was 'Lapins/Gisela-6' (F%=15.6; DD%=0.16) variety but the less affected was 'Daria/IPC' variety (F%=0.35; DD%=0.00).

As regard the brown rot (*Monilia* spp), on the flower buds, the most attacked was 'Ferovia/Gisela-5' variety (F%=18.20; DD%=0.55) and the less attacked was 'Sweetheart/Gisela-12' variety (F%=6.64; DD%=0.13). On fruits, the hardest attack was registered on 'Sweetheart/Gisela-12' variety (F%=23.03; DD%=0.69) and the lower attack was registered on 'Kordia/Weiroot-2' variety.

Based on the data collected in Table 8, using varietal sensitivity index, a classification of the studied cherry cultivars was done, regarding their behavior to the biotic stress caused by the key pathogens, as follow: 'Ferovia/Gisela-5' (VSI%=19.29), 'Lapins/Gisela-6' (VSI%=17.33), 'Skeena/Gisela-5' (VSI%=14.89), 'Daria/IPC' (VSI=12.27), 'Kordia/Weiroot-2' (VSI%=9.34), 'Sweetheart/Gisela-12' (VSI%=7.58).

On peach trees, due the weather conditions registered in the first parts of the vegetation periods, the microclimate was favorable for the peach clock attack (*Taphrina deformans*). The attack was initiated early in March when the attack risk increased from 25% to maximum 100% and lasted till 17 June, than decreased gradually till 30 June up to 25%. The same tendency of the attack risk was registered between 10 July and 10 August. For the shoot hole and the brown rot disease, the attack risks were the same as in the case of the cherry.

Under orchard conditions, the attack of the key pathogens in untreated peach plot, confirmed the predicted attack risk.

Assessment of the data presented in the Table 9 suggest that peach clock attacked hard the varieties 'Filip/Adaptabil' (F%=52.00; DD%=2.60) and 'Jerseyland/Adaptabil' (F%=47.60; DD%=1.90) and lower the variety 'Redhaven/Adaptabil' (F%=43.30; DD%=1.73). The same tendency was registered in the case of the shoot hole attack (*Stigmia carpophyla*), which attacked hard the varieties 'Filip/Adaptabil' (F%=34.70; DD%=1.39) and 'Jerseyland/Adaptabil' (F%=31.70; DD%=1.27) and lower the variety 'Redhaven/Adaptabil' (F%=28.90; DD%=0.87).

As regard the brown rot (*Monilia* spp.), on the shoots, the most attacked varieties were 'Filip/Adaptabil' (F%=26.00; DD%=0.78) and 'Jerseyland/Adaptabil' (F%=23.80; DD%=0.71) and lower the variety 'Redhaven/Adaptabil' (F%=21.70; DD%=0.65). In the case of the brown rot attack on fruits, the hardest attacked was recorded on 'Jerseyland/Adaptabil' (F%=15.90; DD%=0.48), followed by 'Redhaven/Adaptabil' (F%=14.50; DD%=0.44) and 'Filip/Adaptabil' (F%=14.30; DD%=0.43).

Based on the data collected in Table 9, using varietal sensitivity index, a ranking of the studied peach cultivars was done, regarding their behavior to the biotic stress caused by the key pathogens: 'Filip/Adaptabil' (VSI%=5.20), followed by 'Jerseyland/Adaptabil' (VSI%=4.36) and 'Redhaven/Adaptabil' (VSI%=3.69).

On plum trees due the weather conditions registered in the first parts of the vegetation periods, the microclimate for shoot hole (*Stigmia carpophila*) and the brown rot (*Monilia* spp.) was favorable, and the attack lasted from 11 April to 12 August and during 6-9 September. The risk ranged in many periods between 25-90% for shoot hole and 20-25 up to 100% for brown rot (moniliose) as in the case of the cherry. Under orchard conditions, the attack of the key plum pathogens in untreated plot, confirmed the predicted risk.

The shoot hole (*Stigmia carpophyla*) attacked harder the 'Stanley/mirobolan' variety (F%=56.90; DD%=3.41) and lesser the 'Andreea/Adaptabil' variety (F%=14.10; DD%=0.42).

In the case of the red spot (*Polystigma rubrum*), the most attacked variety was 'Stanley/mirobolan' variety (F%=38.00; DD%=0.42) and the less affected was 'Andreea/Adaptabil' variety (F%=12.20; DD%=0.14).

As regard the brown rot (*Monilia* spp.), on the shoots, the most attacked was 'Stanley/mirobolan' variety (F%=32.20; DD%=0.97) and the less affected was 'Cacanska Rodna/Saint Julien' (F%=12.50; DD%=0.38). On the fruits, the heavy affected was 'Stanley/mirobolan' variety (F%=29.10; DD%=0.87) and the less affected was 'Andrea/Adaptabil' (F%=14.50; DD%=0.44).

Based on the data collected in Table 10, using varietal sensitivity index, a classification of the studied plum cultivars was done, regarding their behavior to the biotic stress caused by the key pathogens, as follow: 'Stanley/mirobolan' (VSI%=5.67), 'Centenar/Saint Julien' (VSI%=3.89), 'Carpatin/Saint Julien' (VSI%=2.71), 'Cacanska Rodna' (VSI%=1.97), 'Adreea/Adaptabil' (VSI%=1.53).

On apple trees, the weather conditions registered in the first parts of the vegetation periods, were very favorable for the key pathogen attack, therefore the risk of infections was forecast mainly for fireblight, apple scab and powdery mildew.

In the case of the fireblight (*Erwinia amylovora*), the infections risk on shoots was medium (50%) in 28 April and with oscillations increased to the maximum (100%), till 6 of June. During the summer the fireblight attack risk on shoots was at the maximum level (100%), then decreased in the mid of September (25%) and increased up to maximum level (100%) in 9-10 October (Fig 8).

As regard the apple scab (*Venturia inaequalis*), due the weather conditions, the infections risk stretched out from the 20 March till the end of August and from 11 September till 10 October (Fig. 9). Under orchard conditions, in untreated plot, the attack of the key pathogens of apple confirmed the predicted risk (Table 11-12).

Assessment of the Table 11 and 12 reveals that in untreated plots, fireblight attack was higher on 'Goldrush/M9' (F%=12.50; DD% 0.25) and lower 'Jonagold/M9' clones shoots (F%=1.00; DD%=0.01).

As regard the apple scab (*Venturia inaequalis*), the highest attack was registered on the 'Braeburn/M9' variety (F%=43.10; DD%=1.72 on leaves, F%=28.75%; DD%=0.86 on shoots and F%=26.55% DD%=0.80 on fruits) and the lowest attack was registered at the 'Jonagold de Costa/M9' clone (F%=16.82; DD%=0.34 on leaves, F%=8.51; DD%=0.17 on shoots and F%=4.83%; DD%=0.10 on fruits).

In the case of powdery mildew (*Podosphaera leucotricha*), the highest attack was registered on 'Jonagold Boerenkamp/M9' (F%=22.48; DD%=0.67 on leaves, F%=23.67; DD%=0.71 on shoots and F%=12.10; DD%=0.24 on fruits) and the lowest attack was registered on 'Goldrush/M9' (F%=14.33; DD%=0.29 on leaves, F%=21.41%; DD%=0.64 on shoots, and F%=7.87; DD%=0.16 on fruits).

Based on the data collected in Table 11 and 12, using varietal sensitivity index, a classification of the studied apple cultivars and clones was done, regarding their behavior to the biotic stress caused by the key pathogens, as follow: 'Braeburn/M9' (VSI%=5.12), 'Idared/M106' (VSI%=4.41), 'Golden Reinders/M9' (VSI%=2.48), 'Jonagold de Costa/M9' (VSI%=2.36), 'Jonagold Boerenkamp/M9' (VSI%=2.28), 'Jonagold Novajo/M9' (VSI%=2.24).

C. Results on disease monitoring and disease attack apple fruits obtained in modern superintensive orchards and preserved in conventional cool warehouse

Assessment of the Fig. 11 suggest that weather conditions occurred during the study period were characterized by both thermal and water stress, which affected all the apple varieties and clones taken into the study, inducing micronutrients assimilation deficiency, physiological disorders and increased attack and damages degree of the specific fungi to the storage facilities.

As regard the physiological disorders, the less affected varieties were 'Red Braeburn/M9', with a damage degree DD%=0.24, caused by 'bitter pit' and the clone 'Jonagold Boerenkamp/M9', with a damage degree DD%=0.05, caused by vitrification. The most affected fruits were the ones harvested and stored from 'Topaz/M9' variety on which the damages degree (DD%) caused by 'bitter bit' and the ones caused by vitrification also ranged between 0.11-0.50 for each 'disease'.

A deeper look into the Fig and 12, reveals that under the cool storage conditions, the less affected varieties were 'Jonagold Boerenkamp/M9' touched by *Alternaria* genus (DD%=0.1) and 'Braeburn/M9', affected by *Phytophthora* genus and grey mold - *Botrytis cinerea* (DD%=0.06; respectively DD%=0.18). The most affected fruits were the ones of 'Topaz/M9' variety, on which the damages caused by *Gloeosporium perenans* ranged between DD%=0.21-0.25 and the more serious damages caused by grey mold - *Botrytis cinerea* from DD%=0.05 up to DD%=1.20.

4. Conclusions

Based on the collected data, using varietal sensitivity index (VSI%), a classification of the cherry varieties was done regarding their behavior to the biotic stress caused by the key pests as follow: 'Lapins/Gisela-6' (VSI%=3.79); 'Kordia/Weiroot-2' (VSI%=2.83); 'Ferrovia/Gisela-5' (VSI%=2.48); 'Daria/IPC' (VSI%=2.23); 'Skeena/Gisela-5' (VSI%=2.05); 'Sweetheart/Gisela-12' (VSI%=1.56).

Using varietal sensitivity index, a classification of the studied cherry cultivars regarding their behavior to the biotic stress caused by the key pathogens, as follow: 'Ferrovia/Gisela-5' (VSI%=19.29), 'Lapins/Gisela-6' (VSI%=17.33), 'Skeena/Gisela-5' (VSI%=14.89), 'Daria/IPC' (VSI%=12.27), 'Kordia/Weiroot-2' (VSI%=9.34), 'Sweetheart/Gisela-12' (VSI%=7.58).

Based on the collected data, using varietal sensitivity index (VSI%), a ranking of the studied peach varieties was done, regarding their behavior to the biotic stress caused by the key pests as follow: 'Redhaven/Adaptabil' variety (VSI%=3.91); 'Jerseyland/Adaptabil' (VSI%=2.27), followed by 'Filip/Adaptabil' (VSI%=2.30).

Using varietal sensitivity index (VSI%), a ranking of the studied peach cultivars was done regarding their behavior to the biotic stress caused by the key pathogens, as follow: 'Filip/Adaptabil' (VSI%=5.20), followed by 'Jerseyland/Adaptabil' (VSI%=4.36) and 'Redhaven/Adaptabil' (VSI%=3.69).

Based on the organized data, using varietal sensitivity index (VSI%), a classification of the studied plum varieties was done, regarding their behavior to the biotic stress caused by the key pests as follow: 'Andreea/Adaptabil' (VSI%=7.57), 'Cacanska Rodna/Saint Julien' (VSI%=6.20), 'Carpatin/Saint Julien' (VSI%=5.71), 'Centenar/Saint Julien' (VSI%=5.57) 'Stanley/Mirobolan' (VSI%=4.49).

Using varietal sensitivity index, a classification of the studied plum cultivars was done regarding their behavior to the biotic stress caused by the key pathogens, as follow: 'Stanley/mirobolan' (VSI%=5.67), 'Centenar/Saint Julien' (VSI%=3.89), 'Carpatin/Saint Julien' (VSI%=2.71), 'Cacanska Rodna' (VSI%=1.97), 'Adreea/Adaptabil' (VSI%=1.53).

On apple, the second generation of the apple codling moth, strike harder 'Jonagold Boerenkamp/M9' clone (F%=18.10; DD%=1.09) and lesser 'Goldrush/M9' variety (F%=14.00; DD%=0.70).

Based on the data collected, using varietal sensitivity index, a classification of the studied apple cultivars and clones was done regarding their behavior to the biotic stress caused by the key pathogens, as follow: 'Braeburn/M9' (VSI%=5.12), 'Idared/M106' (VSI%=4.41), 'Golden Reinders/M9' (VSI%=2.48), 'Jonagold de Costa/M9' (VSI%=2.36), 'Jonagold Boerenkamp/M9' (VSI%=2.28), 'Jonagold Novajo/M9' (VSI%=2.24).

As regard the physiological disorders, the most affected fruits were the ones of 'Topaz/M9' variety on which the damages degree caused by bitter bit (DD%) ranged between and the ones caused by vitrification also ranged between 0.11-0.50 for each 'disease'.

The most affected fruits were the ones of 'Topaz/M9' variety on which the damages caused by *Gloeosporium perenans* ranged between DD%=0.21-0.25 and the more serious damages caused by grey mold - *Botrytis cinerea* from DD%=0.05 up to DD%=1.20.

Monitoring of the microclimate conditions using automate weather stations and expert software are the modern tools for the early warning of the pest and pathogens attack in the modern orchards.

The indicators for early diagnosis such as: adults capture sum and average, economic damage threshold (EDT) attack frequency (F%) and intensity (I notes), damages degree (DD%) and varietal sensitivity index (VSI%) and quantification of the biocenotic stress are vital to be known, prior the fruit varieties and clones extent in superintensive fruit growing systems.

The highlighted sensitive varieties on pest and disease attack: 'Lapins' and 'Ferovia' on cherry, 'Redhaven' and 'Filip' on peach, 'Andreea' and 'Stanley' on plum, 'Jonagold Boerenkamp', 'Braeburn' and 'Topaz', might be used as reference indicators, to improve the nutrition and phytosanitary programs efficacy.

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Tables and Figures

Fig. 1. Specific microclimate conditions climadiagram at RIFG Pitesti-Maracineni 1969-2018, Lat. N 44.513; Long. E 24.52; Alt 287m

Table 1. Weather conditions dynamic by month at RIFG Pitesti-Maracineni Lat. N 44,513; Long. E 24,52; Alt. 287m 1.01.-31.12.2017

SpecWare 9 Pro ICDP Specware original Year Summary (by Month) From 01.01.2017 To 31.12.2017

Date	Temperature			Degree Chill		Wet		Rain	
	High	Day	Low	Days	Hours	Days	Hours	Fall	Days
ian	9,8	01	-21,7	10	-4,9	0,0	126,8	0,0	20,0
feb	18,7	23	-11,5	14	1,1	8,0	307,0	0,0	23,0
mar	23,3	24	-3,1	27	8,2	45,9	457,0	0,0	18,0
apr	25,2	28	-4,1	22	9,5	73,4	373,3	24,3	22,0
mai	27,2	31	4,0	11	15,3	170,1	79,0	169,0	31,0
iun	35,8	29	9,0	15	20,8	320,5	2,3	138,3	24,0
iul	35,3	01	9,4	05	21,4	349,3	0,8	154,3	26,0
aug	37,5	05	6,9	24	21,7	352,5	16,8	140,5	24,0
sep	32,4	19	6,1	14	18,9	268,7	44,3	110,8	27,0
oct	31,6	02	-2,2	31	11,7	106,7	356,5	56,3	28,0
nov	17,1	13	-5,6	01	5,3	6,8	584,5	0,5	24,0
dec	15,6	25	-9,3	22	1,6	2,4	426,0	0,0	24,0
						1704,3	2774,0	793,8	291,0
								755,0	127

Table 2. Weather conditions dynamic by month at RIFG Pitesti-Maracineni Lat. N 44.513; Long. E 24.52; Alt. 287m 1.01.-31.10.2018

SpecWare 9 Pro ICDP2015 Year Summary (by Month) From 01.01.2018 To 31.12.2018

Date	Temperature			Degree Chill		Wet		Rain	
	High	Day	Low	Days	Hours	Days	Hours	Fall	Days
ian	15,8	07	-13,1	16	0,6	2,9	419,0	0,0	24,0
feb	13,1	02	-16,1	28	0,6	0,7	389,0	0,0	21,0
mar	21,4	31	-19,8	01	3,7	22,2	365,8	3,8	23,0
apr	29,4	26	-1,1	03	15,3	173,7	120,0	67,5	17,0
mai	30,8	31	7,4	18	17,5	233,5	29,0	130,8	25,0
iun	32,0	12	7,7	24	20,2	306,0	8,0	172,8	26,0
iul	31,2	31	9,7	02	21,0	340,4	1,3	198,5	28,0
aug	33,9	17	12,1	12	22,2	374,9	0,0	184,5	30,0
sep	32,6	02	-1,5	27	17,1	225,8	76,0	78,5	23,0
oct	26,4	31	1,7	26	12,1	107,1	1306,0	27,8	21,0
nov	18,3	04	-11,1	30	4,7	16,3	477,0	10,0	25,0
dec	11,8	23	-9,6	02	-0,3	0,2	326,8	0,0	25,0
						1803,8	2517,8	874,0	288,0
								746,8	168

Table 3. Weather conditions dynamic by month at RIFG Pitesti-Maracineni Lat. N 44.513; Long. E 24.52; Alt. 287m 1.01.-30.10.2019

SpecWare 9 Pro ICDP2015 Year Summary (by Month) From 01.01.2019 To 17.10.2019										
Date	Temperature			Degree Days	Chill Hours	Wet Hours	Wet Days	Rain Fall	Rain Days	
	High	Day	Low							
Jan	10,4	18	-13,5	08	-1,2	0,0	295,5	0,0	19,0	63,7
Feb	19,2	04	-14,1	24	2,6	10,1	380,8	0,0	14,0	14,8
Mar	23,6	18	-4,4	04	7,8	53,2	393,0	1,3	12,0	21,2
Apr	26,3	26	-0,1	21	10,8	70,2	326,0	54,8	22,0	35,6
May	28,2	29	2,4	08	15,7	186,0	106,8	107,0	27,0	46,3
Jun	32,2	13	11,2	30	21,2	335,9	0,0	188,3	30,0	197,1
Jul	34,9	02	7,9	11	21,1	340,8	4,3	135,8	26,0	93,4
Aug	35,1	08	10,2	05	22,8	386,9	0,0	32,8	12,0	9,7
Sep	33,0	03	1,3	21	17,5	232,0	68,8	41,3	13,0	11,9
Oct	27,9	01	0,8	09	12,2	59,8	177,0	42,5	16,0	26,2
						1674,8	1752,0	603,5	191,0	519,9
										105

Fig. 2. The adult's flight dynamics of the cherry fly *Ragoletis cerasi* L, RIFG Pitesti-Maracineni, 1.05--05.08.2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Table 4. The key pest attack (biotic stress) in superintensive cherry orchard RIFG Pitesti-Maracineni, 1.05--30.08, 2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Target Pest	Cherry fly		Bud weevil		Leafroller		Black aphid	
Organs	Fruits		Leaves		Leaves		Shoots	
Variety	F%	DD%	F%	DD%	F%	DD%	F%	DD%
Sweetheart / Gisela-12	42.00	1.26	3.45	0.10	5.14	0.10	4.51	0.09
Skeena / Gisela-5	49.00	1.47	2.86	0.09	10.95	0.33	8.40	0.17
Lapins / Gisela-6	65.00	1.95	2.93	0.09	3.73	0.07	42.00	1.68
Kordia / Weiroot-2	76.50	2.30	4.89	0.15	7.18	0.14	12.20	0.24
Ferovia / Gisela-5	69,75	2.09	4.27	0.13	5.00	0.10	7.95	0.16
Daria / IPC	62.00	1.86	3.75	0.11	4.34	0.09	8.75	0.18
AVG	60.71	1.82	3.69	0,1108	6.06	0.14	13.97	0.42
STDEV	12.9484	0.3546	0.8709	0,0216	2.6655	0.0872	13.9483	0.5655
VAR	21.3288	19.4705	23.5915	19,4836	44.0089	62.5689	99.8534	134.8550

Fig. 3. The adults fly dynamics of peach moth *Cydia molesta* L, RIFG Pitesti-Maracineni, 1.05.--30.08, 2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Table 5. The key pest attack (biotic stress) in superintensive peach orchard RIFG Pitesti-Maracineni, 1.05--30.08, 2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Target Pest	Peach moth G2		Peach moth G2 (at harvest)		Leafroller		Green aphid	
Organs	Fruits		Fruits		Leaves		Shoots	
Variety	F%	DD%	F%	DD%	F%	DD%	F%	DD%
Redhaven / Adaptabil	19.50	0.78	23.60	1.18	0.00	0.00	32.50	1.95
Filip / Adaptabil	23.30	0.70	25.20	1.01	0.00	0.00	25.32	0.51
Jerseyland / Adaptabil	21.70	0.65	27.40	1.10	0.00	0.00	12.20	0.61
AVG	21.50	0.71	25.40	1.09	0.00	0.00	23.34	1.02
STDEV	1.9079	0.0652	1.9079	0.0860	0.0000	0.0000	10.2938	0.8052
VAR	8.8739	9.1831	7.5113	7.8570	0.0000	0.0000	44.1038	78.7788

Fig. 4. The adults fly dynamics of plum moth *Cydia funebrana* L, RIFG Pitesti-Maracineni, 1.05. -- 30.08, 2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Table 6. The key pest attack (biotic stress) in superintensive plum orchard RIFG Pitesti-Maracineni, 1.05--30.08, 2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Target Pests	Plum moth G2		Plum moth G2 (at harvest)		Stones wasp		Leaf rollers		Grey aphid	
Organs	Fruits		Fruits		Fruits		Leaves		Shoots	
Variety	F%	DD%	F%	DD%	F%	DD%	F%	DD%	F%	DD%
Stanley/ mirobolan	20.75	0.62	27.55	1.38	57.00	2.28	15.80	0.47	12.00	0.36
Centenar/ Saint Julien	23.00	0.69	32.33	1.62	64.00	3.20	14.50	0.44	10.70	0.32
Carpatin/ Saint Julien	24.00	0.72	35.50	1.78	60.00	3.00	17.60	0.53	13.50	0.41
C. Rodna/ Saint Julien	27.00	1.08	38.66	1.93	66.00	3.30	16.05	0.48	16.30	0.49
Andreea/ Adaptabil	25.00	1.00	35.33	1.41	75.00	4.50	12.30	0.37	32.10	1.28
AVG	23.95	0.82	33.87	1.62	64.40	3.26	15.25	0.46	16.92	0.54
STDEV	2.3211	0.2036	4.1847	0.2364	6.3443	0.8017	1.9831	0.0595	8.7380	0.4030
VAR	9.6914	24.7585	12.3537	14.5650	9.8514	24.6214	13.0036	13.0036	51.6428	74.4329

Fig. 5. The adults fly dynamics of plum moth *Cydia funebrana* L, RIFG Pitesti-Mărăcineni, 1.05 -- 30.08. 2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Table 7. The key pest attack (biotic stress) in superintensive apple orchard RIFG Pitesti-Maracineni, 1.05--30.08, 2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Target Pest	Apple codling moth G1			Apple codling moth G2		
Organs	Fruits			Fruits		
Variety	F%	I [0-6]	DD%	F%	I [0-6]	DD%
Goldrush / M9	25,00	2,00	0,50	14,00	5,00	0,70
Golden Reiders / M9	23,00	3,00	0,69	19,45	6,00	1,17
Jonagold de Costa / M9	22,25	4,00	0,89	16,75	6,00	1,01
Jonagold Boerenkamp / M9	21,70	4,00	0,87	18,10	6,00	1,09
Jonagold Novajo / M9	26,50	4,00	1,06	14,40	6,00	0,86
Braeburn /M9	27,00	2,00	0,54	13,70	5,00	0,69
Idared / M 106	26,00	3,00	0,78	15,00	5,00	0,75
AVG	24,49	3,14	0,76	15,91	5,57	0,91
STDEV	2,4780	0,8944	0,1997	2,4276	0,4472	0,1890
VAR	10,1172	28,4590	26,2404	15,2542	8,0269	20,7798

Fig. 6. Risk of infections with shoot hole - *Stigmia carpophylla* and brown rot - *Monilia laxa* at stone fruit species, RIFG Pitesti-Maracineni, 1.03. --20.10.2019, Lat. N 44,513; Long. E 24,52; Alt. 287m

Table 8. The key disease attack (biotic stress) in superintensive cherry orchard RIFG Pitesti-Mărăcineni, 1.05--30.08, 2018-2019, Lat. N 44,513; Long. E 24,52; Altitude 287m

Target Diseases	Antracnose		Shoot hole		Brown rot			
Organs	Leaves		Leaves		Flower buds		Fruits	
Variety	F%	DD%	F%	DD%	F%	DD%	F%	DD%
Sweetheart / Gisela-12	5.70	0.11	2.50	0.05	6.64	0.13	23.03	0.69
Skeena /Gisela-5	33.95	1.36	1.75	0.02	12.50	0.38	21.75	0.65
Lapins /Gisela-6	34.10	1.36	15.6	0.16	14.80	0.44	24.10	0.72
Kordia /Weiroot-2	9.15	0.18	0.45	0.00	8.75	0.26	7.00	0.14
Ferovia /Gisela-5	6.25	0.13	0.37	0.00	18.20	0.55	14.00	0.42
Daria /IPC	6.10	0.12	0.35	0.00	11.16	0.33	21.71	0.65
AVG	15.88	0.54	3.50	0.04	12.01	0.36	18.60	0.55
STDEV	14.1124	0.1055	5.9916	0.0100	4.1598	0.0239	6.7116	0.0377
VAR	88.8972	19.3835	171.0247	25.4879	34.6406	6.6381	36.0857	6.8963

Fig. 7. Risk of infections with peach clock - *Taphrina deformans* on peach RIFG Pitesti-Maracineni, 1.03. --20.10.2019, Lat. N 44,513; Long. E 24,52; Alt. 287m

Table 9. The key disease attack (biotic stress) in superintensive peach orchard RIFG Pitesti-Maracineni, 1.05--30.08, 2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Target Diseases	Peach clock		Shoot hole		Brown rot			
Organs	Leaves		Leaves		Shoots		Fruits	
Variety	F%	DD%	F%	DD%	F%	DD%	F%	DD%
Redhaven / Adaptabil	43.30	1.73	28.90	0.87	21.70	0.65	14.50	0.44
Filip / Adaptabil	52.00	2.60	34.70	1.39	26.00	0.78	14.30	0.43
Jerseyland / Adaptabil	47.60	1.90	31.70	1.27	23.80	0.71	15.90	0.48
AVG	47.64	2.08	31.77	1.17	23.82	0.72	14.88	0.45
STDEV	4.3401	0.4596	2.9006	0.2728	2.1701	0.0645	0.8566	0.0262
VAR	9.1103	22.1106	9.1309	23.2334	9.1103	9.0218	5.7553	5.8509

Table 10. The key disease attack (biotic stress) in superintensive plum orchard RIFG Pitesti-Maracineni, 1.05--30.08, 2018-2019, Lat. N 44.513; Long. E 24.52; Alt. 287m

Target Diseases	Shoot hole		Red spot		Brown rot			
Organs	Leaves		Leaves		Shoots		Fruits	
Variety	F%	DD%	F%	DD%	F%	DD%	F%	DD%
Stanley/ mirobolan	56.90	3.41	38.00	0.42	32.20	0.97	29.10	0.87
Centenar/ S. Julien	46.70	2.34	14.80	0.18	24.60	0.74	21.30	0.64
Carpatin/ S. Julien	32.50	1.30	31.60	0.35	19.40	0.58	15.90	0.48
C. Rodna/ S. Julien	17.30	0.52	36.40	0.39	12.50	0.38	22.70	0.68
Andreea/ Adaptabil	14.10	0.42	12.20	0.14	17.80	0.53	14.50	0.44
AVG	33.50	1.60	26.60	0.30	23.80	0.64	20.70	0.62
STDEV	18.4499	1.2723	12.2229	0.1276	5.6569	0.2240	5.8395	0.1752
VAR	55.0744	79.6065	45.9509	43.1058	23.7683	35.0544	28.2102	28.2102

Fig. 8. Risk of infections with fireblight - *Erwinia amylovora* on apple RIFG Pitesti-Maracineni, 1.01.--20.10.2019, Lat. N 44,513; Long. E 24.52; Alt., 287m

Fig. 9. Risk of infections with apple scab - *Venturia inaequalis* on apple RIFG Pitesti-Maracineni, 1.01.--20.10.2019, Lat. N 44,513; Long. E 24.52; Alt., 287m

Table 11. The key disease attack (biotic stress) in superintensive cherry orchard RIFG Pitesti-Maracineni, 1.05--30.08, 2018-2019, Lat. N 44,513; Long. E 24.52; Alt. 287m

Target Disease	Fireblight	Apple scab			Powdery mildew		
Organs	Shoots	Leaves	Shoots	Fruits	Leaves	Shoots	Fruits
Variety	F%	F%	F%	F%	F%	F%	F%
Goldrush / M9	12.50	15.83	10.57	7.10	14.33	21.41	7.87
Golden Reiders / M9	9.98	16.33	14.40	8.60	16.60	26.70	9.80
Jonagold de Costa / M9	1.00	16.82	8.51	4.83	28.33	20.66	14.10
Jonagold Boerenkamp / M9	1.00	14.08	11.46	6.72	22.48	23.67	12.10
Jonagold Novajo / M9	1.00	15.45	10.15	6.78	20.25	25.45	10.65
Braeburn / M9	10.00	43.10	28.75	26.55	18.00	27.20	9.15
Idared / M 106	12.00	40.86	27.43	25.57	15.30	25.57	8.52
AVG	3.28	15.11	10.47	7.64	19.33	24.38	10.31
STDEV	4.9240	12.3112	8.1700	8.9624	4.6031	2.6546	1.9797
VAR	149.9922	81.469	78.0541	117.3085	23.817	10.8886	19.197

Table 12. The key disease attack (biotic stress) in superintensive cherry orchard RIFG Pitesti-Maracineni, 1.05--30.08, 2018-2019, Lat. N 44,513; Long. E 24.52; Alt. 287m

Target Disease	Fireblight	Apple scab			Powdery mildew		
Organs	Shoots	Leaves	Shoots	Fruits	Leaves	Shoots	Fruits
Variety	DD%	DD%	DD%	DD%	DD%	DD%	DD%
Goldrush / M9	0.25	0.32	0.21	0.14	0.29	0.64	0.16
Golden Reiders / M9	0.20	0.33	0.29	0.17	0.50	0.80	0.20
Jonagold de Costa / M9	0.01	0.34	0.17	0.10	0.85	0.62	0.28
Jonagold Boerenkamp / M9	0.01	0.28	0.23	0.13	0.67	0.71	0.24
Jonagold Novajo / M9	0.01	0.31	0.20	0.14	0.61	0.76	0.21
Braeburn / M9	0.20	1.72	0.86	0.80	0.54	0.82	0.18
Idared / M 106	0.24	1.63	0.82	0.77	0.31	0.77	0.17
AVG	0.13	0.70	0.40	0.32	0.54	0.73	0.21
STDEV	0.1151	0.6668	0.3059	0.3159	0.1997	0.0765	0.0435
VAR	87.5827	94.7114	76.8387	98.5453	37.1595	10.4653	21.1137

Fig. 10. The varietal sensitivity index (VSI%) for the studied fruit trees varieties RIFG Pitesti-Maracineni, Lat. N 44,513; Long. E 24.52; Alt., 287m

Fig. 11. Depreciation degree of the stored apples due to thermal and water stress occurred in 2018, RIFG Pitesti Maracineni 23--25.03.2019

Fig. 12. Depreciation degree of the stored fruits caused by the contamination with mycotic pathogens specific to the storage period, RIFG Pitesti Maracineni 10.09.2018--23-25.03.2019