

EFECTUL APLICĂRII PROGRAMELOR DE FITOPROTECȚIE ȘI A CĂRBUNELUI NEGRU ASUPRA SĂNĂTĂȚII LIVEZILOR MODERNE DE MĂR THE EFFECT OF PHYTOPROTECTION PROGRAMS AND BLACK CHARCOAL APPLICATION ON APPLE ORCHARDS DISEASES HEALTH

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Abstract

This paper presents the effects of phytoprotection programs and black charcoal application in a superintensive apple orchard. The 2008 and 2009 years, were very favorable to apple orchards diseases. Based on biological reserve estimated in the orchard and computer aid forecasts, 'standard' and 'integrated' phytoprotection programs were precisely applied. The phytoprotection programs provided good to very good disease control of the cultivars against apple scab and powdery mildew, and were in accordance with the cultivars genetic background (diseases behavior). Under the 2008 and 2009 conditions, the most resilient apple scab proved to be 'Jonagored' and 'Fuji Kiku Clone 8' cultivars. Black charcoal incorporation into the orchards soil increased its retention capacity for water, organic and mineral substances and stimulated its microbial activity, especially for the fungi species involved in green manure and cellulose transformation as well as for saprophytes species and antagonistic of the plants and soil born pathogenic fungi as well.

Keywords: măr, protecție fitosanitară, cărbune negru, microbiologia solului

Cuvinte cheie: apple, orchard phytoprotection, black charcoal, soil microbiology

1. Introduction

Modern fruit growing development requires a great deal of effort to reduce the inputs, optimize the orchard exploitation technologies and better valorize of the yield, combined with the attention paid for orchard ecosystem, environment and consumer health as well. For this reason, in the case of the modern orchards, the appropriate phytoprotection became an important part in the integrated fruit production systems as well as combined fruit production systems, including ecological sequences. Among these sequences, innovative plant protection products and new ingredients are used, to keep the pest and diseases under economical damage thresholds, to prevent the formation of resistant population and strains and to produce high quality fruits (Amzar, 2002, 2003; Brun et al., 2005, Perju 2005, Sumedrea et al., 2006, Șerboiu et al. 2001, Teodorescu et al. 2000, 2001, 2003, 2006, Tomșa, 2003) Concomitantly the production technologies are driven to increase the orchard ecosystem stability and productivity, increase the soil organic matter content, reduce the conventional energy needs and decrease the carbon emission (Glaser et al, 2002, Nishio, and Okano S., 1991, Sumedrea et al., 2006; Steiner, Teixeira et al. 2007).

2. Material and methods

During the 2007-2009, the experiences were set up in a super intensive orchard type, with planting distance of 3.25 x 1.0 m (3,077 trees/ha). The experimental design was a poly-factorial one and included 36 variants (3 x 6 x 2) with 5 trees in replicate plot, disposed according to sub-divided plot method. The factors studied included: **A factor - the cultivar:** the biological material was represented by 'Jonagored', 'Fuji Kiku Clone 8' and 'Golden Delicious Clone B', grafted on 'M9 T337'; **B factor - fertilizers doses,** applied concomitant with the irrigation water had 6 graduations: **b1** - untreated control, and annually fertilized with the following nutrients amounts: **b2** -N₂₀:P₂O₅₁₀:K₂O₃₀:MgO₁₀, **b3**- N₄₀:P₂O₅₂₀:K₂O₆₀:MgO₂₀, **b4** - N₆₀:P₂O₅₃₀:K₂O₉₀:MgO₃₀, **b5** - N₈₀:P₂O₅₄₀:K₂O₁₂₀:MgO₄₀, **b6** - N₁₀₀:P₂O₅₅₀:K₂O₁₅₀:MgO₅₀; **C factor** - 2 pest and diseases management systems, 'standard' and 'integrate' using plant protection products with low impact on the environment and the users. Supplementary, in the year 2008, **D factor the charcoal dose** was added with 4 graduations: **d1** - untreated control variant - without black charcoal use, **d2** - black charcoal 1Kg/m²; **d3** - black charcoal 5Kg/m² and **d4** - black charcoal 10Kg/m². The black charcoal applied in the experience was produced and supplied by Biophan Ltd., Curtea-de-Arges, Romania.

The experimental device is located on a plane ground situated on the second terrace of the Arges River, the soil being brown eumezobasic, low podzolic and pseudogleic ones. The soil reaction is slightly acid (pH 5.8- 6.8) up to very acid (pH 4.8 – 4.9) and therefore the soil needs amendments. Humus content is in generally low, under 3%, and for this reason the soil is poor in nitrogen. The soil analysis of saturation with bases level indicate that soil has a low to medium natural fertility.

Orchard ground management was with grass covered between the trees rows and cleared with herbicides on a 1.0-1.2 m wide strip, along the trees rows.

The meteo data were monitored and registered with the WatchDog digital weather station. Its software served also to forecast the phytosanitary treatments at the right moment.

To assess the attack caused by the pathogenic fungi *Venturia inaequalis* - apple scab and *Podosphaera leucotricha* - powdery mildew, were assessed more than 1000 leaves, 150 shoots and 150 fruits per variant, recording the healthy and the injured organs for each species of pathogen. The damages caused by the pest and pathogens were estimated both as attack frequency (F%) and as attack intensity (I). The attack frequency was calculated using the formula: $F = n / N \times 100$, where, n = number of affected organs, and N = total number of the de observed organs. For the attack intensity (I) was used the scale 0-6, where, note '0' = lack of strike and note '6' = strike between 76 and 100%. The phytosanitary treatments were applied using the OSELLA 1000 spraying machinery powered by U 650 DTC tractor. Biological efficacy of the treatments was assessed periodically.

From the soil samples were realised water suspensions and then were initiated fungi cultures on artificial growing media. The associated fungi genus and species grown were observed both under the stereomicroscopes Carl-Zeiss DDR and Bell-Photonics and then examined under an IOR ML-4 microscope.

The great amount of experimental data were stored, processed and represented in a graphical form using SpecWare 9.0, software and MS 2003 Excel 7.0 as well.

3. Results and discussions

I. Results on apple trees infection risk with key diseases

A quick look at the figures 1-4 shows that the years of 2008 and 2009, were favorable to the key diseases of the apple orchards the apple scab and the powdery mildew.

The analysis of figure 1 show that in 2008 the best conditions for apple scab - *Venturia inaequalis* infections were from April to October (except the month of July), but assessment of the figure 2 reveal that in 2009 the best conditions for apple scab infections were from May to July and from the end of August up to October. During these periods, many times, the leaf wet period was higher than 15 hours and the forecasted attack intensity I [notes] was ranging between 5 and 7.

The examination of the figure 3 reveal that in 2008 that the best condition for powdery mildew - *Podosphaera leucotricha* infections were from May to September, but the analysis of figure 4 show that in 2009 the best condition for powdery mildew infections were from June to October. In these periods many times the forecasted conidial maturity index was higher than 50% and the forecasted attack intensity was at the superior top of the scale.

Based on biological reserve estimated in the orchard and the forecasts elaborated with Specware 9.0 professional software, nine to then treatments with fungicides were precisely carried on.

These treatments were included in more complex phytoprotection programs, standard or integrated, designated to control key pest diseases in the experimental orchard. (See table 1 - 4).

II. Results on apple cultivars resilience and responses to phytoprotection programs

Analysis of figures 5 and 6 shows that, in 2008, in the treated variants, the damages produced by apple scab -*Venturia inaequalis* was lower on the apples trees treated in the standard phytoprotection program than in the integrated ones, the mean attack frequency (F%) ranging between 16.33-21.33% on leaves and 3.33-8.00% on fruits. The mean attack intensity I [notes] on leaves was oscillated between 3.33 and 4.00. Under such circumstances the less affected cultivars were 'Jonagored' and 'Fuji Kiku Clone 8'.

Assessment of the figures 7 and 8 shows that in the treated variants, the damages produced by powdery mildew -*Podosphaera leucotricha* were lower on the apples trees treated in the standard phytoprotection program than in the integrated ones, the mean attack frequency (F%) oscillating between 6.75 - 8.28% on leaves and 2.50-3.25% on shoots. The mean attack intensity I [notes] on leaves was oscillated between 3.00-4.00 on leaves and 4.50-5.00 on shoots. Under the 2008 conditions, the most resilient proved to be the 'Jonagored' cultivar.

Comparatively, in the figures 9 and 10 can be observed that in 2008, in untreated control variants, the damages produced by apple scab -*Venturia inaequalis* were very high, the mean attack frequency (F%)

ranging between 46.00% on leaves and 17.2% on fruits. Also, the damages produced by powdery mildew - *Podosphaera leucotricha*, the mean attack frequency (F%) ranging between 44.40% on leaves and 26.20% on shoots.

It can be concluded that, phytoprotection programs applied in the year of 2008 provided a good to very good protection to the cultivars grown in the experimental orchard.

Analysis of figures 11 and 12 show that, in 2008, in the treated variants, the damages produced by apple scab - *Venturia inaequalis* was lower on the apples trees treated in the standard phytoprotection program than in the integrated ones. The mean attack frequency (F%) ranging between 8.57-23.33% on leaves and 13.00-20.00% on fruits. The mean attack intensity I [notes] on leaves oscillated between 2.00-3.00 on leaves and 2.00-2.67 on fruits. Under such circumstances the less affected cultivars were 'Jonagored' and 'Golden Delicious Clone B'.

Assessment of the figures 12 and 13 highlight that in the treated variants, the damages produced by powdery mildew - *Podosphaera leucotricha* were lower on the apples trees treated in the standard phytoprotection program than in the integrated ones, the mean attack frequency (F%) oscillating between 3.33 - 8.28% on leaves and 3.00-3.50% on shoots. The mean attack intensity I [notes] on leaves was oscillated between 2.00 on leaves and 2.50-3.50 on shoots. Under the 2009 conditions, the most resilient proved to be the 'Fuji Kiku Clone 8' cultivar.

Comparatively, in the figures 14 and 15 can be observed that in 2009, in untreated control variants, the damages produced by apple scab - *Venturia inaequalis* were very high, the mean attack frequency (F%) ranged between 84.30% on leaves and 87.8% on fruits. Also, the damages produced by powdery mildew - *Podosphaera leucotricha*, the mean attack frequency (F%) oscillated between 84.30% on leaves and 30.00% on shoots.

These facts can be explained by the cultivars genetic background, the reserve of apple scab and powdery mildew conidia and mycelium in the untreated control variants, the favorable weather condition for the infection, and use in the integrated phytoprotection program of the low risk contact fungicides but without any adjuvant. In such conditions the foliage, the shoots and the apples were partially protected, especially during the second part of the vegetation period.

For these reasons, at the end of the vegetation period, additional treatments were needed, in order to reduce the pathogens reserve (the inoculum source for the initial infections in 2010 springtime).

It can be concluded that, phytoprotection programs applied in the year of 2009 provided a good protection to the cultivars grown in the experimental orchard especially in the first part of the vegetation period.

III. Results regarding the soil microbiology

The lab experimentss were carried out to evidence the activity of the orchard soil fungal community, one year after black charcoal application. To reveal the main fungi taxa living in the soil of the experimented variants, various artificial growing media were used. On these media, but especially on PDA (potato-dextrose-agar 40 g/l), was noticed the abundant development of some fungi genus well known as pathogens or potential pathogens as *Alternaria*, *Aspergillus*, *Cladosporium*, *Penicillium*, and *Verticillium*, *Fusarium*, *Mucor*, *Rhizopus*, *Monilia* but also some other genera as *Dactylaria*, *Humicola* (*sin. Scoleobasidium*), *Myrothecium*, *Paecylomyces*, *Sporobolomyces* etc., involved in green manure degradation, with potential influence on soil fertility improvement. Among the saprophyte species *Trichoderma harzianum* and *Trichoderma viride* are now well known for their remarkable capacity to transform the cellulose from the green manure and ground cover waste, also for their role as antagonists of the soil borne pathogens.

The obtained results are presented in the charts 17 to 21.

By assessment of the figure 18 can be observed that in the untreated control variants, the main fungi genus and species that isolated and grown on standard PDA media were *Aspergillus* spp. (33.3%), *Coemansia* spp. (11.1%), *Paecylomyces* spp. (22.2%), *Penicillium* spp. (22.2%) and *Verticillium terreum* (11.0%), the ratio between the fungi genera was 3:1:2:2:1.

The analysis of the figure 19 reveal that in the soil of the experimental variants treated with black charcoal at a rate of 1 kg/m², the main fungi genera and species that developed on standard PDA media were *Alternaria* spp. (14.3%), *Aspergillus glaucus* (14.3%), *Coemansia* spp. (14.3%), *Paecylomyces* spp. (28.6%), *Penicillium* spp. (14.3%), *Verticillium terreum* (14.3%), the ratio between the genera and species changed at 1:1:1:2:1:1. The dominance of the *Paecylomyces* spp. in the soil of these variants, can be an reliable indicator of the active cellulose transformation by the microorganisms.

The examination of the figure 20 reveal that in the soil of the variants treated with black charcoal at a rate of 5 kg/m², the most important fungi genera and species that were isolated and grown on standard PDA media were *Aspergillus fumigatus* (12.5%), *Cladosporium herbarum* (25.5%), *Coemansia* spp. (25.5%), *Myrothecium roridum* (12.5%), *Penicillium* spp. (12.5%) and *Verticillium terreum* (12.5%), the ratio between

the genera and species being 1:2:2:1:1:1. The dominance of the *Cladosporium herbarum* in the soil of these variants, can be a reliable indicator of the organic matter transformation at the interface with the applied black charcoal. Also, the presence of fungus *Myrothecium roridum* in the soil extracts obtained from these variants, and its development on the growing media, was associated with the process of decomposition of the roots and green manure waste derived from *Leguminosae* family plants (McKemy and Morgan-Jones G., 1991, Leath, and Kendall, 1983). Also the white clover was present in the orchard floor of the plot, trimmed and incorporated with the occasion of the orchard soil management works.

Analysis of the figure 21 shows that in the soil of the variants treated with black charcoal at a rate of 10 kg/m², the main genera and species of fungi isolated and grown on the standard growing media PDA were *Alternaria* spp. (12.5%), *Aspergillus* spp. (25.0%), *Cladosporium herbarum* (12,5%), *Coemansia* spp. (12.5%), *Paecylomyces* spp. (25.0%), and *Penicillium* spp. (12.5%), the ratio between genera and species being 1:2:1:1:2:1.

4. Conclusions

Based on biological reserve estimated in the orchard and the forecasts elaborated with Specware 9.0 professional software, in 2008 and 2009, the phytosanitary treatments were precisely carried on to protect a modern superintensive apple orchard.

The phytoprotection programs applied in the year 2008 provided a good to very good protection to the cultivars grown in the experimental orchard.

The phytoprotection programs applied in the year 2009 provided a good protection to the cultivars grown in the experimental orchard especially in the first part of the vegetation period.

The high frequency of the apple scab symptoms registered in some variants at the end vegetation period of 2009 can be explained by: the cultivars genetic background, the reserve of apple scab conidia and mycelium in the untreated control variants, the favorable weather condition for the infection, and use in the integrated phytoprotection program of the low risk contact fungicides but without any adjuvant. In such conditions the foliage, the shoots and the apples were partially protected, especially during the second period of the vegetation period.

The black charcoal incorporated into the orchards soil has the property to adsorb on its surface the organic and mineral substances and the water as well, increasing the soil retention capacity due to the charcoal microstructure.

The phytopathogen species belonging to the genera *Fusarium*, *Monilia*, *Pytium* and *Rhizoctonia*, identified with significant frequencies in the experience soil, had the status of constants or accesoria of the soil fungal community, but the saprofit species as *Trichoderma harzianum* and *Trichoderma viride*, are well known both as cellulose transforming species and antagonists of the soil borne pathogens.

Isolation and growing of some fungi species as *Cladosporium herbarum* represent a reliable indicator of the organic matter transformation at the interface with the fragments of black charcoal, but isolation of some fungi as *Paecylomyces* spp., *Sporobolomyces* and *Myrothecium roridum* represent reliable indicators of the stimulation of cellulose transformation and decomposition of the green manure waste and herbs roots belonging to the orchard floor, with favorable on soil fertility.

The orchards exploitation technologies must be drivenn to increase the orchard ecosystem stability, productivity and competitiveness, by reduction of the conventional energy needs, decrease of the carbon emission and increase the soil organic matter content, induction of soil microbiological re-equilibration, by stimulation of the beneficial and antagonists species and stimulation of the physical and chemical processes mediated by the soil microbiological community.

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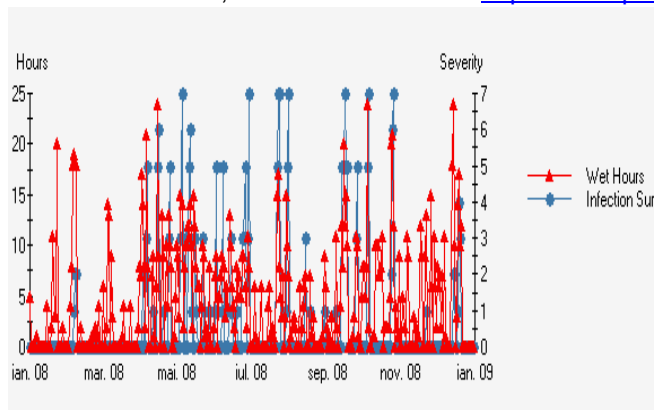


Fig. 1. Assessment of the apple scab -*Venturia inaequalis* infection risk RIFG Pitesti, Romania, 2008.

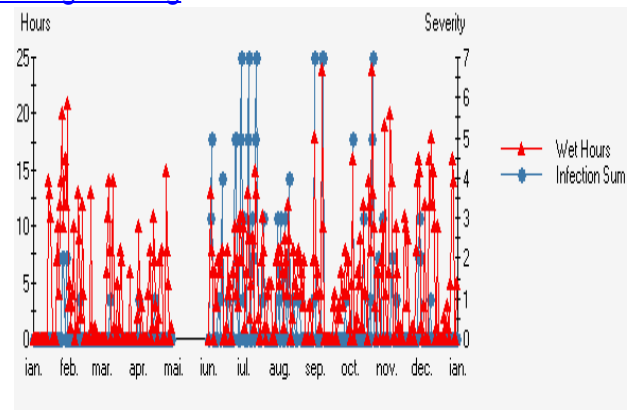


Fig. 2. Assessment of the apple scab -*Venturia inaequalis* infection risk RIFG Pitesti, Romania, 2009.

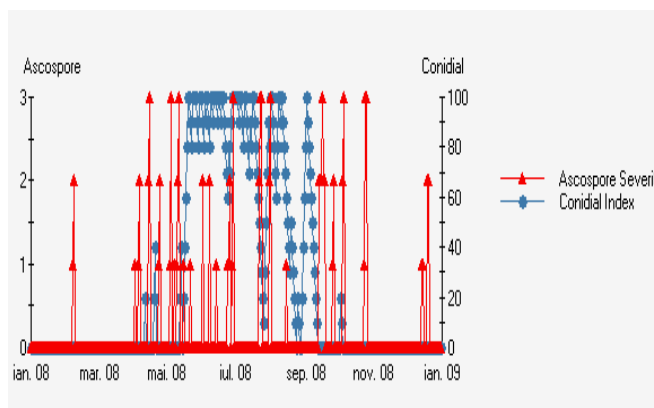


Fig. 3. Assessment of the powdery mildew -*Podosphaera leucotricha* infection risk, RIFG Pitesti, Romania, 2008.

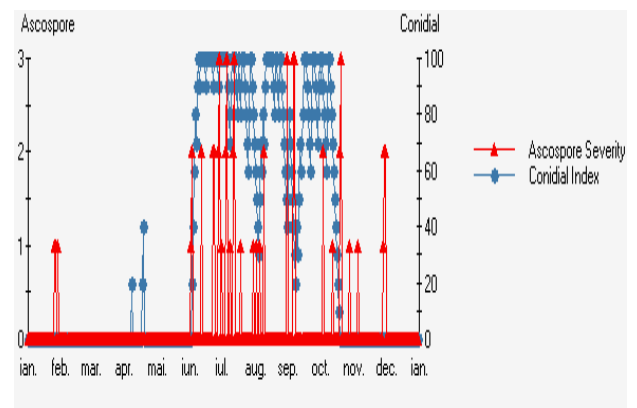


Fig. 4. Assessment of the powdery mildew -*Podosphaera leucotricha* infection risk, RIFG Pitesti, Romania, 2009.

Table 1. 'Standard' phytoprotection program for superintensive apple orchards (RIFG Pitesti, Romania, 2008)

Period /Date	Treatment	Pest and diseases	Products and concentration applied
25.02.2008	T1	San Jose scale, Aphids mites and caterpillars eggs,	Confidor Oil conc. 1,5%
14.03.2008	T2	Powdery mildew, Flower weevil	Kumulus S 0,3% + Sinoratox 35 EC conc. 0,2%
22.04.08 blooming period	T3	preventive against fireblight <i>Erwinia amylovora</i>	Aliette 80 WG conc. 0,3%
29.04.2008	T4	Apple scab, powdery mildew, leaf miners G1T1	Zato conc. 0,013% + Mancozeb conc. 0,2% + Nurelle D conc. 0,075%
07.05.2008	T5	Rapăn, făinare, <i>Cydia pomonella</i> , G1T1	Stroby DF conc. 0,013% + Actara 25 WG conc. 0,03%
19.05.2008	T6	Apple scab, powdery mildew, <i>Cydia pomonella</i> , G1T2	Sythane C conc. 0,1% + Reldan 40 EC conc. 0,15%
29.05.2008	T7	Apple scab, powdery mildew, aphids	Superchamp conc. 0,2% + Bumper 250 EC conc. 0,03% + Actara 25 WG conc. 0,03%
11.06.2008	T8	Apple scab, powdery mildew leaf miners G2T1	Mancozeb conc. 0,2% + Bumper 250 EC conc. 0,03% + Nurelle D conc. 0,075%
25.06.2008	T9	Apple scab, powdery mildew, mites	Manzate 75 DF conc. 0,2% + Bumper 250 EC conc. 0,03% + Omite 57 E conc. 0,1%
11.07.2008	T10	Apple scab, powdery mildew, aphids, leaf miners G2T2,	Sythane C conc. 0,1% + Vantex 60 CS conc. 0,08%
21.07.2008	T11	Apple scab, powdery mildew leaf miners G2T2	Manzate 75 DF conc. 0,2% + Bumper 250 EC conc. 0,03% + Vantex 60 CS conc. 0,08%
04.08.2008	T12	Apple scab, powdery mildew <i>Cydia pomonella</i>	Sythane C conc. 0,1% + Nurele D 50/500 conc. 0,075%
27.08.2008	T13	Apple scab, powdery mildew, storage diseases, <i>Cydia pomonella</i>	Topsin M 70 conc. 0,1% + Rimon 10 EC conc. 0,06%
07.10.2008	T14	Apple scab, powdery mildew, storage diseases,	Cuprofert 3S conc. 0,3%

Table 2. 'Integrated' phytoprotection program for superintensive apple orchards (RIFG Pitesti, Romania, 2008)

Period /Date	Treatment	Pest and diseases	Products and concentration applied
25.02.2008	T1	San Jose scale, Aphids mites and caterpillars eggs,	Confidor Oil conc. 1,5%
14.03.2008	T2	Powdery mildew, Flower weevil	Kumulus S 0,3% + Caliypso 480 SC conc. 0,02%
22.04.08 blooming period	T3	preventive against fireblight <i>Erwinia amylovora</i>	Aliette 80 WG conc. 0,3%
29.04.2008	T4	Apple scab, powdery mildew, leaf miners G1T1	Funguran OH conc. 0,3% + Thiovit Jet conc. 0,3% + Carpovirusin conc. 0,1%
07.05.2008	T5	Apple scab, powdery mildew, <i>Cydia pomonella</i> , G1T1	Superchamp conc. 0,3% + Sulfomat 80 PU conc. 0,3% + Calypso 480 SC conc. 0,02%
19.05.2008	T6	Apple scab, powdery mildew, <i>Cydia pomonella</i> , G1T2	Cuprofert 3S conc. 0,3% + Thiovit Jet conc. 0,3% + Insegar 25 WG conc. 0,04%
29.05.2008	T7	Apple scab, powdery mildew, aphids	Kendal TE conc. 0,3% + Tiovit Jet conc. 0,3% + Calypso 480 SC conc. 0,02%
11.06.2008	T8	Apple scab, powdery mildew, leaf miners G2T1	Funguran OH conc. 0,3% + Thiovit Jet conc. 0,3% + Insegar 25 WG conc. 0,03%
25.06.2008	T9	Apple scab, powdery mildew, mites	Superchamp conc. 0,3% + Sulfomat 80 PU conc. 0,3% + Omite 57 E conc. 0,1%
11.07.2008	T10	Apple scab, powdery mildew, aphids, leaf miners G2T2,	Funguran OH 500 conc. 0,3% + Thiovit Jet conc. 0,3% + Rimon 10 EC conc. 0,06%
21.07.2008	T11	Apple scab, powdery mildew, leaf miners G2T2	Kendal TE conc. 0,3% + Sulfomat conc. 0,3% + Insegar conc. 0,03%
04.08.2008	T12	Apple scab, powdery mildew, <i>Cydia pomonella</i>	Superchamp conc. 0,3% + Thiovit Jet conc. 0,3% + Calypso 480 SC conc. 0,02%
27.08.2008	T13	Apple scab, powdery mildew, storing diseases, <i>Cydia pomonella</i>	Cuprofert Zinc 0,03% + Sulfavit conc. 0,3% + Insegar conc. 0,03%
07.10.2008	T14	Apple scab, powdery mildew, storing diseases	Cuprofert 3S conc. 0,3%

Table 3. 'Standard' phytoprotection program for superintensive apple orchards (RIFG Pitesti, Romania, 2009)

Period /Date	Treatment	Pest and diseases	Products and concentration applied
27.03.2009	T1	San Jose scale, Aphids mites and caterpillars eggs,	Oleocarbotox conc. 1,5%
06.04.2009 bud brake start	T2	Apple scab, powdery mildew	Zeama bordeleză conc. 0,5% + Bumper 0,03%
15.04.2009 mouse ear-blooming start	T3	Powdery mildew, Flower weevil	Chorus 75 WG conc. 0,02% + Antracol 70 WG conc. 0,2% + Faster 10 EC conc. 0,025%
04.05.2009 10-25% petal fall	T4	Apple scab, powdery mildew, leaf miners	Orius 25 EW conc. 0,05% + Vondozeb conc. 0,2% + Faster 10 EC conc. 0,025%
18.05.2009 fruit set	T5	Apple scab, powdery mildew, <i>Cydia pomonella</i> T1G1, mites	Systhane C conc. 0,1% + Antracol conc 0,2% + Agrofos Super conc. 0,075% + Omite conc. 0,1%
27.05.2009	T6	Apple scab <i>Cydia pomonella</i> T2G1, acarieni	Topsin 500 SC conc. 0,14% + Vondozeb 0,2% + Novadim Progres 0,1%
03.06.2009	T7	Apple scab, powdery mildew	Systhane Forte conc. 0,02% + Vondozeb 0,2%
10.06.2009	T8	Apple scab, leaf miners	Topsin M70 PU conc. 0,1% + Merpan 50 WP 0,2% + Agrofos Super 0,1%
24.06.2009	T9	Apple scab, powdery mildew <i>Cydia pomonella</i> T1G2, aphids	Systhane C PU conc. 0,1% + Merpan 50 WP conc. 0,25% + Vantex 60 CS conc. 0,015%
14.07.2009	T10	Apple scab, <i>Cydia pomonella</i> T2G2, aphids	Bravo 500 SC conc. 0,25% + Calypso 480 SC conc. 0,02%
27.07.2009	T11	aphids, mites	Reldan 40 EC conc. 0,15% + Nissorun conc. 0,03%
10.08.2009	T12	Storing diseases + San Jose scale	Topsin 500 SC conc. 0,14% + Decis 2,5 WG conc. 0,003%
26.08.2009	T13	Storing diseases + San Jose scale	Topsin 500 SC conc. 0,14% + Decis 2,5 WG conc. 0,003%

Table 4. 'Integrated' phytoprotection program for superintensive apple orchards (ICDP Pitești-Mărăcineni, 2009)

Period /Date	Treatment	Pest and diseases	Products and concentration applied
27.03.2009	T1	San Jose scale, Aphids mites and caterpillars eggs,	Confidor Oil conc. 1,5%
06.04.2009 bud brake start	T2	Apple scab, powdery mildew	Superchamp conc. 0,3% + Sulfomat 80 PU conc. 0,3%
15.04.2009 blooming start	T3	Powdery mildew, Flower weevil	Stroby DF conc. 0,013 + Aectra 25 WG 0,03%
04.05.2009 10-25% petal fall	T4	Apple scab, powdery mildew, leaf miners	Aliette 80 WP conc. 0,3% + Calypso 480 SC conc. 0,02%
18.05.2009 fruit set	T5	Apple scab, powdery mildew, <i>Cydia pomonella</i> T1G1, mites	Cuprofert Zinc conc. 0,3% + Sulfomat 80 PU conc. 0,3% + Carpovirusin conc. 0,1%
27.05.2009	T6	Apple scab <i>Cydia pomonella</i> T2G1, acarieni	Kendal T conc. 0,3% + Thiovit Jet conc. 0,3% + Insegar conc. 0,04%
03.06.2009	T7	Apple scab, powdery mildew	Superchamp conc. 0,3% + Thiovit Jet conc. 0,3%
10.06.2009	T8	Apple scab, leaf miners	Kendal T conc. 0,3% + Sulfomat 80 PU conc. 0,3% + Carpovirusin conc. 0,04%
24.06.2009	T9	Apple scab, powdery mildew <i>Cydia pomonella</i> T1G2, aphids	Superchamp conc. 0,3% + Actara 25 WG conc. 0,03%
14.07.2009	T10	Apple scab, <i>Cydia pomonella</i> T2G2, aphids	Funguran OH conc. 0,3% + Sulfavit 80 PU conc. 0,3% + Actara 25 WG conc. 0,03%
27.07.2009	T11	aphids, mites	Funguran OH conc. 0,3% + Sulfavit 80 PU conc. 0,3% + Calypso 480 SC conc. 0,03%
10.08.2009	T12	Storing diseases + San Jose scale	Kendal T conc. 0,3% + Thiovit Jet conc. 0,3% + Calypso 480 SC conc. 0,04%
26.08.2009	T13	Storing diseases + San Jose scale	Superchamp conc. 0,3% + Carpovirusin 0,1%

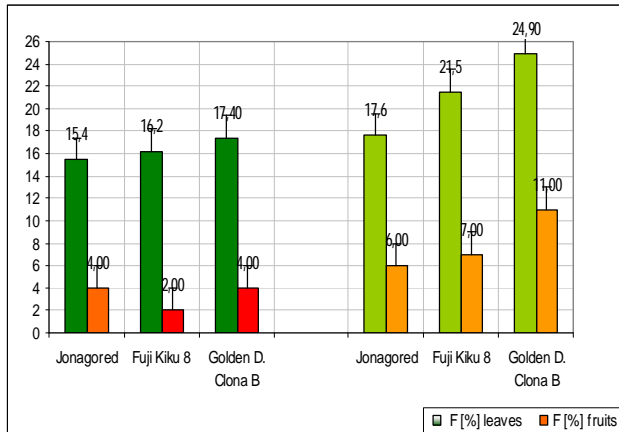


Fig. 5 Apple scab frequency in treated variants RIFG Pitesti, 2008, [mean (16.33-21.33; 3.33-8.00); stdev (1.0066-3.6529; 1.1547-2.6458)]

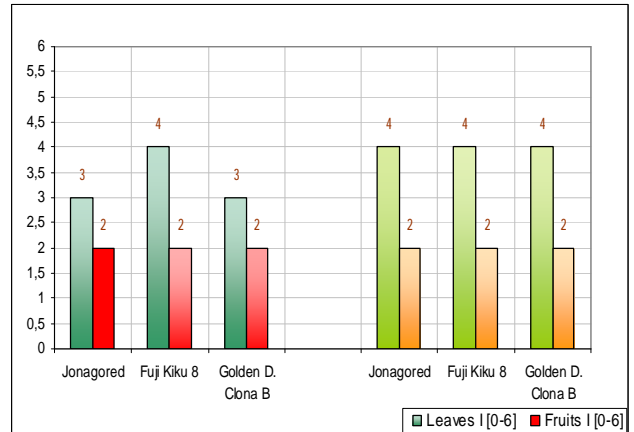


Fig. 6 Apple scab intensity in treated variants RIFG Pitesti, 2008, [mean (3.33-4.00; 2.00); stdev (0.5774-0.0000; 0.000)]

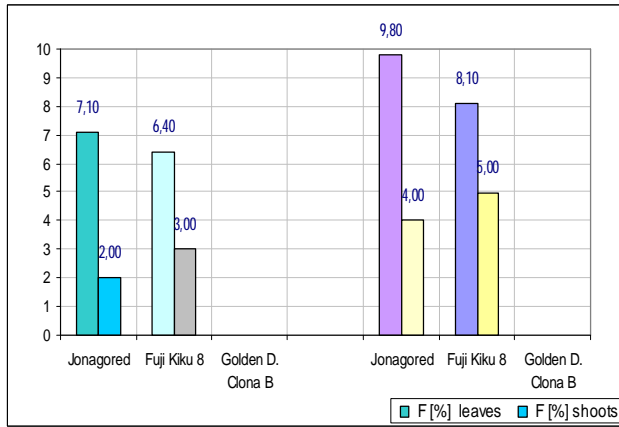


Fig. 7. Powdery mildew frequency in treated variants, RIFG Pitesti, 2008, [mean (6.75 - 8.28 ; 2.50-3.25); stdev (0.4950-1.2021 ; 0.7071)]

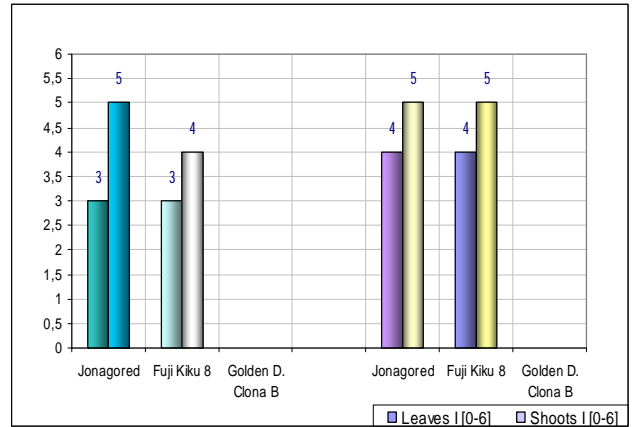


Fig. 8. Powdery mildew intensity in treated variants, RIFG Pitesti, 2008, [mean (3.00-4.00; 4.50-5.00); stdev (0.0000 ; 0.7071)]

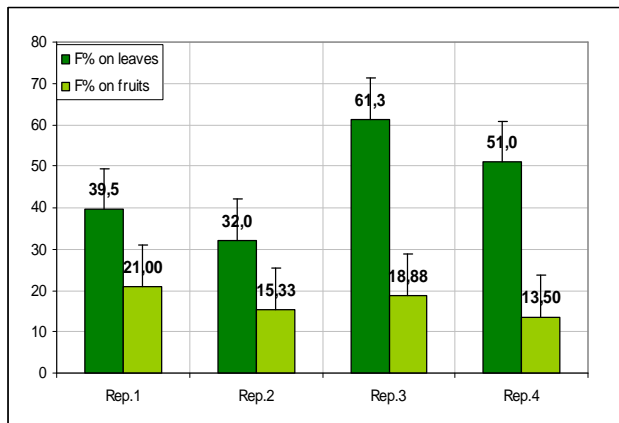


Fig. 9. Apple scab -*Venturia inaequalis* frequency in untreated control variants RIFG Pitesti, 2008, [mean (46.00; 17.2); stdev (12.8754; 3.3886)]

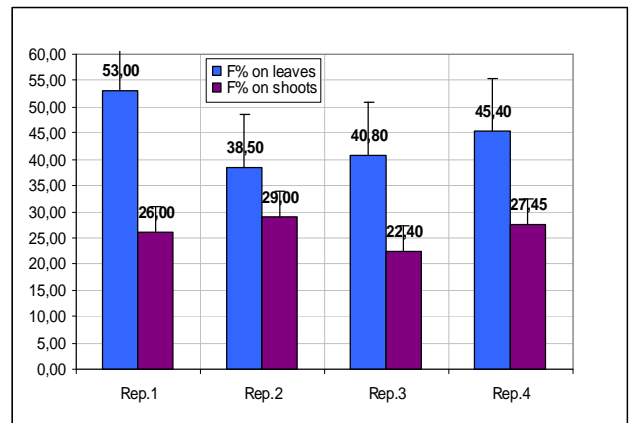


Fig. 10. Powdery mildew attack frequency in untreated control variants RIFG Pitesti, 2008, [mean (44.40; 26.20); stdev (6.3960; 2.8215)]

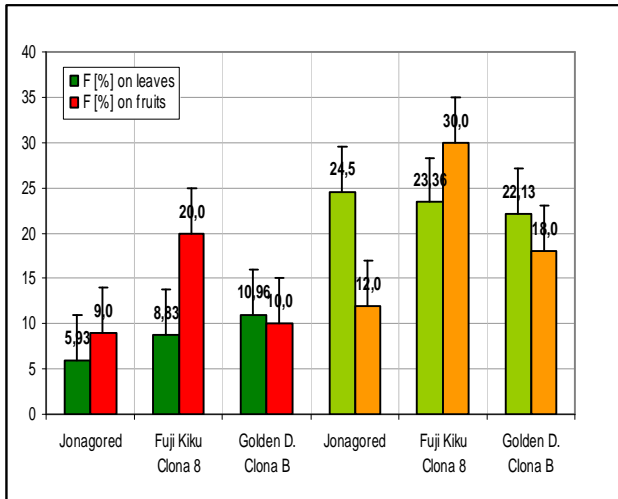


Fig. 11. Apple scab frequency in treated variants, RIFG Pitesti, 2009, [mean (8.57-23.33; 13.00-20.00); stdev (2.5248-1.1853; 6.0828-9.1652)]

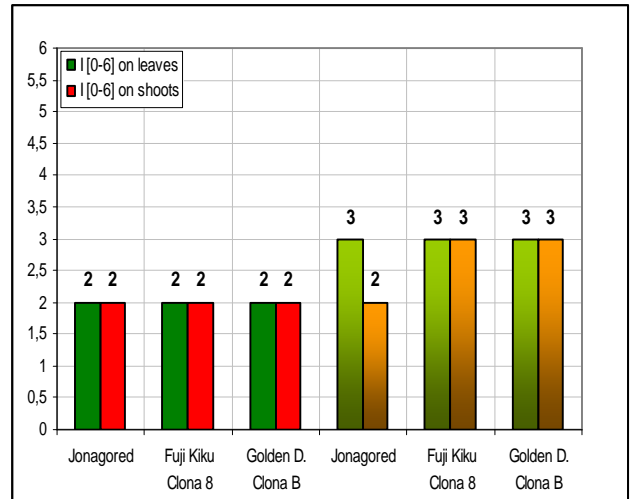


Fig. 12. Apple scab intensity in treated variants (RIFG Pitesti, 2009), [mean (2.00-3.00; 2.00-2.67); stdev (0.0000; 0.0000-0.5774)]

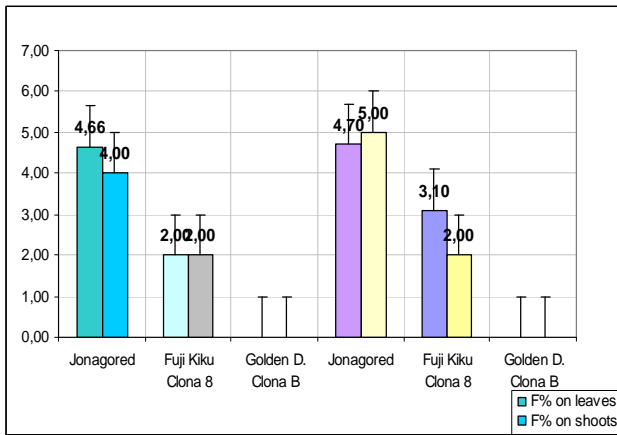


Fig.13 Powdery mildew frequency in treated variants, RIFG Pitesti, 2009, [mean (3.33-3.90; 3.00-3.50); stdev (1.8809-1.1317; 1.4142-2.1213)]

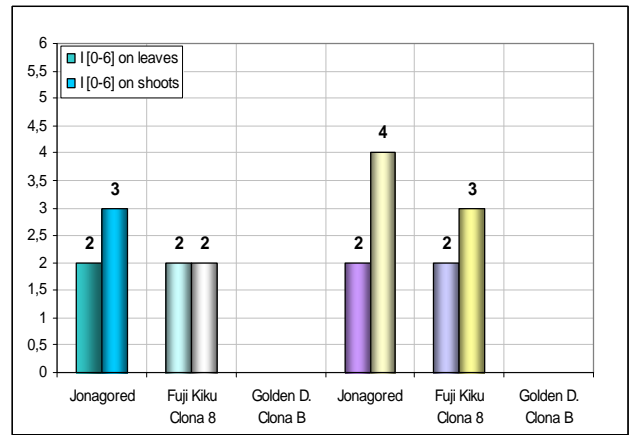


Fig.14 Powdery mildew intensity in treated variants, RIFG Pitesti, 2009, [mean (2.00; 2.5-3.5); stdev (0.0000; 0.7071)]

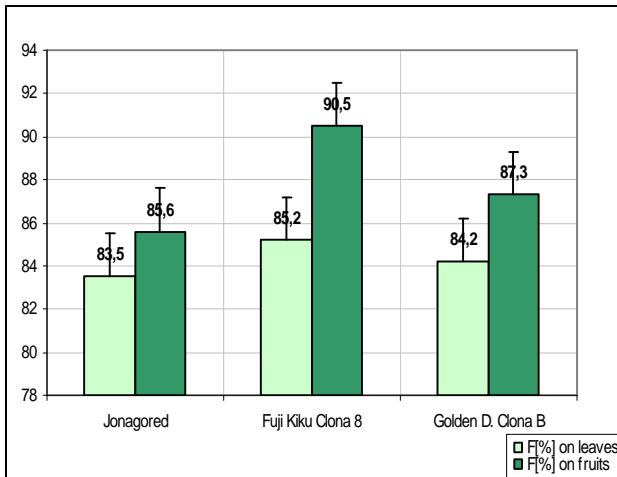


Fig.15. Apple scab frequency in untreated variants, RIFG Pitesti, 2009, [mean (84.3; 87.8); stdev (0.8544; 2.4880)]

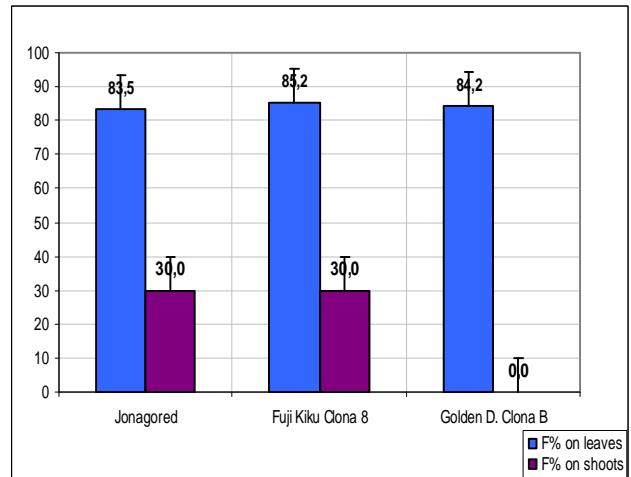


Fig.16. Powdery mildew frequency in untreated variants, RIFG Pitesti, 2009, [mean (84.3; 30.0); stdev (1.9799; 0.000)]

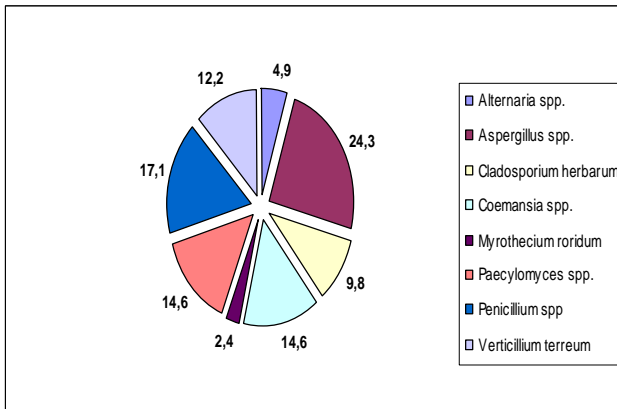


Fig. 17. The ratio between the main fungi genus and species isolated from the experimental variants and grown on standard artificial media PDA.

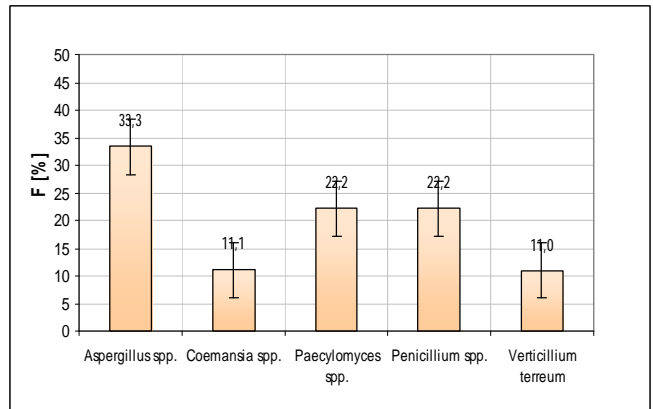


Fig. 18. Frecvency of the main genus in untreated control variants.

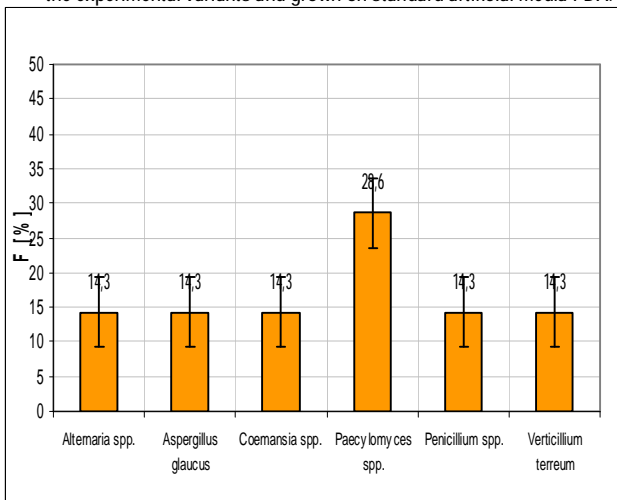


Fig. 19. Frequency of the main genus in the variants 2 and 6

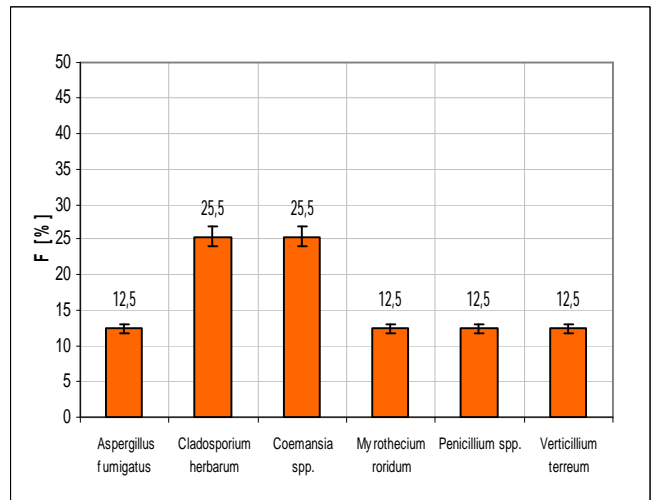


Fig. 20. Frequency of the main genus in the variants 3 and 7

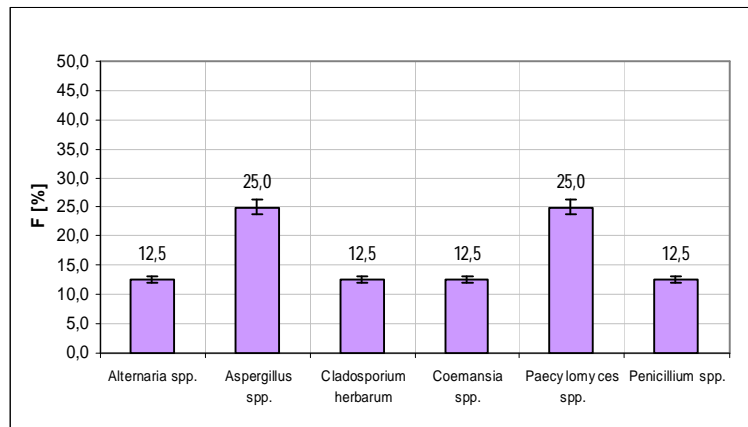


Fig. 21. Frequency of the main genus in the variants 4 and 8