

THE DYNAMICS OF THE BROWN ROT ATTACK - *MONILINIA FRUCTIGENA* (HONEY), IN THE APPLE ORCHARDS IN SIBIU- DURING 2007 – 2009

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Abstract: I've been noticing the dynamics of the pest agent *Monilinia fructigena* Honey on the apple culture from 2006 up to 2008, in the pedoclimatic conditions of Sibiu. The observations were made both during the vegetative growing and dormant period of the culture on: knowing the fungus biology, the biological reserve of the pest agent, the level of the attack, the establishment of the optimum moment and the opportunity to apply the phyto-sanitary treatments, the legal products for the protection of plants that were used on the territory of the county in the studied years, the apple areas affected by. The research in this domain must be permanently made. The methods and the materials, that were used, are both classical and modern, made in the context of the persistent growth of the agro systems of the apple orchards and can lead to very modern research on the quality of the crop, and to the residues of the chemical substances in the fruit, according to the present law- COMES I., LAZĂR A., DRĂCEA A., BOBEȘ I., HATMAN M.- (1977), N. MINOIU (1980), TĂNASE C., ȘESAN E.T. (2006), PĂRVU M. (2003), IACOMI B., VLAD F.F. (2006), the Ministry of Agriculture and Rural Development-(Pesticides residues in plants and vegetables). The practical implications of the research, made by annual observation of the dynamics of the brown rot attack in the apple orchards in Sibiu, led to the issues of the warning systems for an integrated combat against the pest agents, in order to implement a system for applying the plant protection products that fight against the fungus pest agents, according to the community standards. Knowing the dynamics of the attacks on the *Monilinia fructigena* Honey fungus in the apple orchards in Sibiu, the most adequate protective measures, made in the context of a long lasting development of the horticultural agroecosystems, can be scientifically.

Key words: brown rot, plant protection products, plant treatment, frequency of attack

INTRODUCTION

Monilinia fructigena species is a parasite that causes the disease known as “the brown rot” and the mummification of the fruit apple (*Malus domestica*). The brown rot is one of the most widespread diseases of apple, causing damage both in orchards and in deposits during storage (COMES I, LAZĂR AL. DRĂCEA A., BOBEȘ I., HATMAN M., 1977). In the climatic conditions in our country, the most often and characteristic attack is at the fruit (RĂDULESCU E., DOCEA E., 1966). Sometimes an attack may occur early on very young fruit. Late infections occur during harvest or transport of fruit and is manifested by the appearance of brown or black rot in warehouses (TĂNASE C., ȘESAN T.E., 2006).

MATERIAL AND METHODS

Observations were made during the dormant and active during the apple crop, in terms of understanding the biology of the fungus, the symptoms of attack, prevention and control of fungus *Monilinia fructigena*. The biological material used in experiments consisted of shoots, leaves, flowers and fruit.

The macroscopic and microscopic analysis were performed in the diagnosis laboratory of Sibiu Phytopathology Unit, using phytopathological methods, classical mycological isolation

and identification of pathogens (HULE A. 1969, CONSTANTINESCU O. 1974, TĂNASE C., ŞESAN E.T, 2006). Biostatistics data was used to study the desired biological process, experimental data are collated in graphical tables (MĂRUŞTERI M., 2005). Mycotic pathogens attack, the main classification of apple, Annex 1, Ministry of Agriculture Forestry and Rural Development, in 1998 (Table 5).

RESULTS AND DISCUSSIONS

Sibiu territory belongs in an extent of approx. 75% to a moderate-continental climate sector (climate of the hills) and a rate of approx. 25% sector of mountain climates. Because the geographical settlement of Sibiu includes all forms of relief, it imposed its division of the four areas as follows: Agnita, Apoldu de Sus, Dumbraveni and Sibiu. To establish a suitable scheme of treatment it was necessary to follow and correlate the climatic data with the biology of the fungus, the apple phenology, the plant protection products that were used.

1. Environmental factors recorded in the four county microzones, years 2007-2009, are shown in Tables 1,2,3 and the averages of the last 10 years in Figures 1,2,3.

Table 1

Monthly and annual average temperature (°C) Agnita areas, Apoldu de Sus, Dumbrăveni and Sibiu, 2007-2009 (the source-Sibiu Phytosanitary Unit, processed by A. Timar)

Month /year	Agnita			Apoldu de Sus			Dumbrăveni			Sibiu		
	2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
January	1.7	-2.2	-3.4	4.0	-3.3	-2.8	-3.4	-2.0	-2.1	4.1	-2.0	-2.4
February	2.0	1.2	-2.0	6.4	0.8	-0.6	-3.2	1.6	-0.2	6.3	1.2	-0.2
March	6.5	4.5	2.3	11.7	6.2	4.1	7.7	7.0	3.2	11.0	6.6	4.3
April	9.1	9.0	10.5	14.4	10.9	12.1	11.3	16.3	10.7	14.6	11.2	12.4
May	16.3	13.8	13.9	19.7	15.7	15.1	19.9	15.0	15.7	19.9	15.0	15.5
June	19.5	17.9	17.3	25.0	19.4	17.4	18.5	21.1	18.8	23.5	19.8	18.7
July	20.4	18.4	18.9	21.8	19.8	20.5	21.4	20.3	20.4	21.9	20.4	20.1
August	19.4	19.0	18.2	21.7	20.4	20.1	23.4	20.6	20.3	19.9	21.2	19.5
September	12.4	12.4	14.2	13.9	13.0	17.0	15.8	13.9	15.3	13.6	13.4	15.5
October	8.1	8.8	8.6	9.2	9.9	10.8	7.7	10.5	8.8	9.0	10.6	9.8
November	6.0	2.0	4.8	2.5	6.2	7.2	4.3	2.6	6.8	8.5	4.5	6.4
December	-1.9	-0.9	-1.2	1.8	1.4	0.6	-0.3	1.1	1.0	0.5	1.6	1.8
ANNUAL AVERAGE	9.9	8.6	8.5	12.6	10.0	10.5	10.2	11.3	9.9	12.7	10.2	10.1

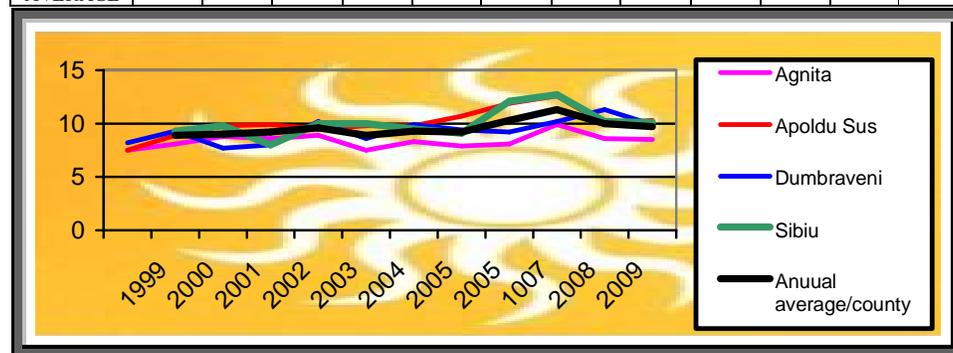


Figure 1: Average annual air temperature °C, period 1999-2009

1998 shows an increase in the average annual temperature in all four areas, representative of Sibiu. This is due to higher temperatures recorded in winter and extreme

temperature changes between day and night from March to April. This requires measures to combat the pathogen earlier than in previous years.

Table 2

Monthly and annual average humidity (U%) Agnita areas, Apoldu de Sus, Dumbrăveni and Sibiu in 2007-2009 (the source-Sibiu Phytosanitary Unit, processed by *A. Timar*)

Month/year	Agnita			Apoldu de Sus			Dumbrăveni			Sibiu		
	2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
January	90	84	91	92	85	96	92	90	85	92	85	84
February	86	81	88	88	78	86	94	80	78	20	78	80
March	74	82	80	78	69	65	73	79	69	76	69	65
April	67	86	61	69	71	58	85	64	75	69	75	58
May	76	76	69	75	69	65	75	70	69	75	69	65
June	77	76	74	78	74	83	87	66	69	77	69	74
July	73	74	76	60	81	76	85	65	61	60	61	76
August	87	74	79	77	79	79	87	74	67	77	67	79
September	89	82	76	77	89	68	85	68	81	77	81	76
October	90	87	86	61	92	74	88	87	72	86	72	83
November	86	87	89	82	91	67	84	72	64	83	64	82
December	88	90	99	83	75	95	99	85	75	89	75	82
ANNUAL AVERAGE	82	81	81	77	79	76	86	75	72	79.2	72	75

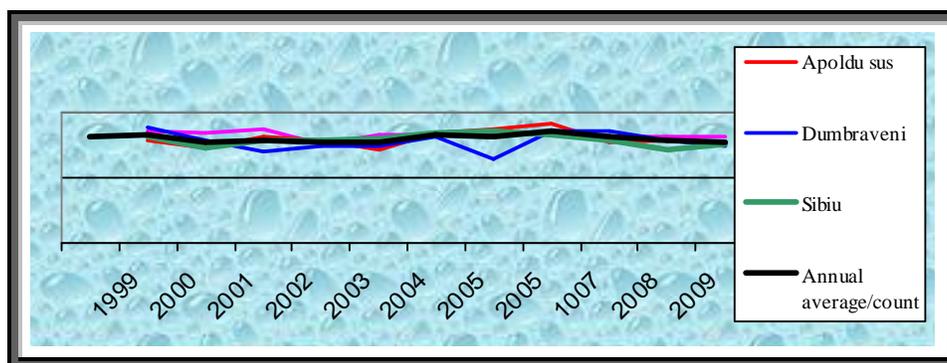


Figure 2: Annual average atmospheric humidity U% during 1999-2009

The monthly average air humidity values range between 77-83%, with an average of 80% in the past 10 years. Air humidity in the microclimate Dumbrăveni is lower in most years compared to the annual average recorded in the county, in Agnita air humidity over the 10 years was higher than the annual average/county. The annual average in Apoldu de Sus presents positive and negative humidity fluctuations compared to the annual average/county, and in Sibiu air humidity is close as a value to the annual average value/county.

The average annual rainfall amounts vary from 374,6 to 983,1 l/mp, they do not have a uniform distribution in the microclimates during the months or the year.

The winds are prevailing in the NW and SE and have an annual average rate that oscillates between 1,8 and 4,5 m/s in Sibiu and 1,5 and 6,5 m / s at the mountains, at Paltinis.

Table 3

Monthly and annual amount of atmospheric precipitation in Agnita, Apoldu de Sus, Dumbraveni and Sibiu, in 2007-2009 (the source-Sibiu Phytosanitary Unit, processed by A. Timar)

Month/ year	Agnita			Apoldu de Sus			Dumbrăveni			Sibiu		
	2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
January	32.5	4.4	12.4	32.8	12.9	19.8	19.4	6.0	13.2	37.3	32.8	28.6
February	48.2	3.4	51.3	33.2	13.7	50.0	17.0	10.2	62.2	28.2	22.8	62.2
March	30.0	70.8	45.4	39.9	52.0	53.0	22.4	75.0	64.0	44.4	59.0	59.0
April	22.8	88.0	16.0	2.2	76.0	15.1	8.6	53.0	13.2	14.4	94.6	22.0
May	121.0	87.2	32.0	124.1	80.8	43.0	100.2	81.0	54.8	100.2	80.6	54.3
June	45.5	42.5	125.4	27.9	112.2	96.5	105.2	15.8	150.4	51.8	40.4	195.6
July	105.0	13.3	70.0	80.6	123.9	171.6	74.0	6.1	106.6	82.8	6.2	146.6
August	132.4	29.6	68.0	168.4	52.6	42.2	17.4	7.2	65.6	164.0	56.2	72.2
September	126.6	61.8	30.0	80.4	43.3	4.6	2.0	39.2	8.0	95.2	57.8	7.6
October	61.2	92.2	84.6	80.8	67.9	67.0	12.0	105.2	86.2	57.8	171.6	110.6
November	44.7	40.0	34.0	54.1	67.0	13.0	67.7	53.4	43.4	45.0	36.0	25.0
December	20.6	25.4	52.1	23.7	48.3	57.2	60.4	13.2	48.4	19.4	23.6	95.0
ANNUAL AMOUNT	790,5	558,6	621,2	748,1	750,6	633,0	506,4	465,3	716,0	740,5	681,6	878,7

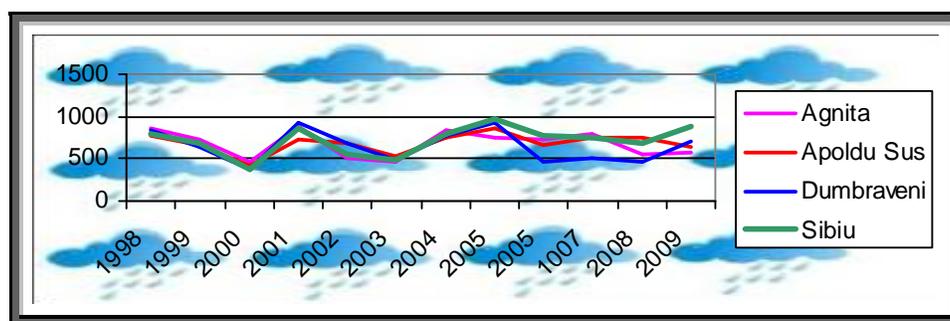


Figure 3: The amount of annual precipitation l/mp, the period 1999-2009

2. Biology and biological reserved mushroom:

Every autumn both in apple orchards where the culture technology was applied and in not treated orchards, the ascospore potential dose (A.P.D.) was raised. Evaluation was done according to program CEEEX Project no. 23/2006- POMOSAT - IACOMI B., VLAD F.F. 2006.

In spring, according to the specialized methodology, on the trees there were installed greased blades, to capture ascospores. They were trapped in the apple orchards of the four county microzone, when average daily air temperature recorded value of 5-6°C, respectively the end of March 2007 and 2009 and in 2008 in early April, in all years corresponding to the phenological phase "on the vegetation – flourished".

During vegetation, the first attack symptoms were reported as follows:

- in untreated orchards - symptoms were first reported in the phase of the "shaking the inflorescences";
- in treated orchards-first symptoms were present during the active growth of the fruit, after mid-July.

Prevention and pest control mycotic agent *Monilinia fructigena* was done by a complex of measures that are part of an integrated control system as follows:

- before winter treatments there were gathered all mummified fruit from trees and under trees;
- shoots attacked by grooming operations have been removed and burned;
- in some orchards there was carried out the plowing between rows of leaf-bearing trees for the incorporation of fungi;

To prevent and combat fungal agent in the three years of study, it was necessary to apply phytosanitary treatments as follows:

➤ first treatment was performed during the "dormant until the swelling buds" - as in autumn A.D.P. was great ;

➤ the second treatment was applied in phenological phase "ascension inflorescences - until blooming "- (fungus were captured, climatic conditions were favorable for the development of fungus). This treatment is considered the "key" as to protect the flower during the 10-15 days after flowering to start shaking petals;

➤ the third treatment has been applied to "start shaking petals" in the years when the period during flowering were recorded rainfall, high humidity.

The following treatments were performed with plant treatments against apple scab (a large range of approved pesticides are approved for proper scab and brown rot) and insects favouring the brown rot infections.

Apoldu de Sus is prone to hail. In 2007, 2008 phytosanitary treatments were recommended for protection, applied immediately after the fall of hail (Figure 4). Plant protection products applied were those that had as an active substance the copper (role in wound healing), to protect crop trees, holding companies have protected orchards with hail netting system (Figure 5).



Figure 4: The brown rot attack on the fruits damaged by hail (14.VII 2009)



Figure 5: Anti-hail system

➤ Prior to 15-20 days (depending on product protection applied) of fruit-crop, treatments were applied for diseases of deposit protection.

Based on studies regarding *Monilinia fructigena* damaging agent, there has been issued a "warning bulletin,, (differentiated into four microzones) to establishments with agricultural profile, companies and individuals that have the apple crop in the county and the Central Laboratory of Quarantine Bucharest .

Structure of the apple crop from Sibiu expressed in Table no. 4.

In orchards where the technology was observed during the last 3 years of study, there were applied a number of 6-7 chemical plant protection treatments against the brown rot.

In late August, early September, surveys were conducted to assess attacks on fruit (Table 6) according to Annex 1 MPDR (Table 5) in terms of fungal pathogen *Monilinia fructigena*.

The assessment of attack, respectively the attack frequency of fruit was in early September each year, before harvesting the fruit.

Table 4

The area planted with apple-ha, orchards and trees stray organized in Sibiu in 2007, 2008, 2009 (the source-Department for Agriculture and Development Rural Sibiu AGR)

Year	Total area apple/county - hectares, of which:		
	Total	Organized orchards	Ha / Scattered trees/number of pieces
2007	3339	2337	1002/ 200.369*
2008	2946	1998	948/ 189.623*
2009	2828	1936	892/178.546*

Legend: * Number of scattered trees are converted to hectares, number trees/ha 200.

Table 5

Classification of the attack of the main pathogens of apple mycotic (Annex 1, Ministry of Agriculture Forestry and Rural Development, in 1998)

Name of disease	M.U.	Attack assessment				
		Weak	Middle	Strong	Very strong	Extremely strong
<i>Monilinia fructigena</i>	fruit%	< 3	3-10	10-30	30-60	> 60

Table 6

Assessment of attack, surface attack, Sibiu county

Year	Apple area ha	No attack ha	The attack ha	Attack assessment - hectares				
				Weak	Middle	Strong	Very strong	Extremely strong
2007	3339	-	3390	620	1480	930	340	20
2008	2946	-	2946	480	1350	856	250	10
2009	2828	-	2828	560	1570	538	160	-

The attack occurred in low and middle groves has been applied technology culture and a powerful attack and very strong and was recorded on stray tree plantations that did not apply phytosanitary treatments over the years.

In Table 7 is shown the average number of phytosanitary treatments applied to the entire surface of apples (orchards where the culture technology was applied, not worked orchards, gardens, trees of the population) in 2007-2009.

Table 7

The surface of treated apple (physically, conventionally) against the brown rot, the number of treatments in 2007, 2008, 2009 (the source: Sibiu Phytosanitary Unit, processed by A. Timar)

Year	The surface-hectares		
	Physical	Conventional	No. treatment/ha
2007	1245	3185	2,55
2008	1096	3029	2,76
2009	1278	2808	2,19

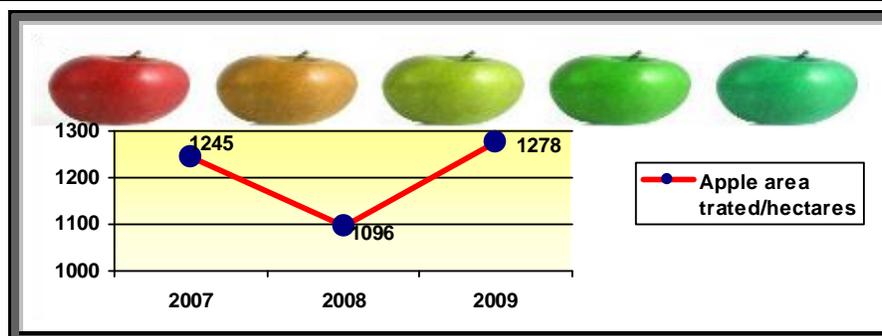


Figure 6: Surface of treated apples in Sibiu - hectares in 2007, 2008, 2009

Plant protection products used in making treatment plant in 2007, 2008, 2009 against *Monilinia fructigena* agent in Sibiu were Alcupral 50PU, Bravo 500 SC, Captan 50 WP, Captadin PU, Chorus 75 WG, Dithane M 45, Dithane Neotec, Funguran OH 300 SC, Merpan 50WP, MN Novozir 80, Score 250 EC, Systhane 12 E, Systhane C PU, Systhane Forte, Copper sulphate, Topsin 70 PU, Topsin 70 WDG.

CONCLUSIONS

❖ For a rationally combination of the different methods of combat, it is necessary to create an organizational agrotechnical base, this part of the system based on integrated control of fruit-growing ecosystem include: environmental factors, the study agrocultural-system, agro-technical measures, forecasting and warning... .

❖ To combat the brown rot attack, in terms of Sibiu's ecopedoclimatic conditions, it is necessary to apply a treatment plant dormant period annually (November-beginning of March) and 5-6 treatments during the crop growing season.

❖ Attack of early primary infection: the highest attacks were reported in the first period of shaking petals. The attack symptoms were present on herbaceous shoots, young leaves, flowers in orchards (trees), where the culture technology is not applied.

❖ Infections of the largest plantations where the hail struck, the attacks by pests or diseases which cause lesions, and in years when rain falls and cool time.

❖ During the period of fruit growth after mid-July, attack symptoms were present on fruit, since they were in close dependence with the attack of the pests (moth, worm in the apple fruit).

❖ Frequency of "weak" attack was noted on orchards (trees) where culture technology is applied (by cutting the attacked shoots and those which had mummified fruit, burial of fallen leaves, chemical treatments applied during the dormant and growing for both the pest and pathogen causing lesions on fruit (by puncture or gnawing).

❖ To maintain the health of the culture, fruits containing very low levels of pesticide residues, and with the least possible negative implications on environment protection, treatments were performed in the warning bulletins issued by the Phytosanitary Unit Sibiu.

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