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# RESULTS REGARDING THE BEHAVIOR OF SOME APPLE CULTIVARS TO DISEASES AND PESTS IN SUSTAINABLE CULTURE

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#### Abstract

This work present the behaviour to diseases and pests of 12 apple cultivars with different origin ('Aura', 'Rumina', 'Jonaprim', 'Rustic', 'Rebra', 'Redix', 'Orion', 'Luna', 'Rubinola', 'Topaz', 'Goldrush' and 'Crimson Crisp'), located in a field trial of RIFG Pitești, Romania, managed in ecological system. In 2023 observations regarding the behaviour of these cultivars at the fire blight and the codling moth were made. In order to prevent bacterial infections, in the ecological variants the product Blossom Protect (2 applications during the flowering period) was used. Observations regarding the attack caused by Erwinia amylovora, were made on short fruit formations (100 leaves) and on shoots (50). The results were expressed as a percentage as a frequency of the attack. Of the 12 cultivars studied, the 'Topaz' cv. proved to be the most sensitive, the frequency of attack in the lot treated with Blossom Protect being 8.25% on short fruiting shoots and 0.08% on shoots, much smaller compared to the group standard (F=20.55% on short fruiting formations, 0.24% on shoots). For the monitoring of the pest Cydia pomonella, AtraPom pheromone traps were used. In the first generation, the frequency was 20.2%. In the second generation the frequency of the attack was between 0.0-0.5% compared to the untreated variant where the frequency was 33%.

Keywords: apple, cultivars, diseases, pests, ecological system.

## **1. INTRODUCTION**

The main objectives of apple breeding program from worldwide and Europe are resistance to diseases and pests and high fruits quality (Militaru et al., 2015).

Regarding resistance to diseases and pests, the most widespread agents of damage to the apple culture in Romania are scab (*Venturia inaequalis* Cke.), codling moth (*Cydia pomonella*) and aphid (*Aphis pomi*) etc. which causes large crop losses. Also, in the last years the fire blight attack has been very aggressive, causing great damage in apple orchards from our country.

In order to manage these problems, farmers applied more than 18 phytosanitary treatments annually, from which 12 phytosanitary treatments are for scab control (Chatzidimopoulos et al., 2020), 5–7 treatments against powdery mildew (Gañán-Betancur et al., 2021), and more than nine treatments for codling moth control (Joutei and Targui, 2003).

Despite the fact that the use of plant protection products has a positive influence on the health of fruit trees, they also have a negative influence on the environment and human health (Militaru et al., 2015; Iordănescu et al., 2023).

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This is why recently researchers have focused on identifying new methods and techniques to reduce the use of pesticides in commercial plantations.

Cultivars which are at least tolerant to the major diseases (scab and fire blight) and pests (aphids and codling moth) are preferred by farmers who cultivate fruit trees in an ecological system (Militaru et al., 2015; Papp et al., 2015).

Regarding the creation of new cultivars resistant to diseases and pests, the results of breeding programs have been very significant in terms of resistance to scab, powdery mildew and fire blight, but insignificant in terms of resistance to aphids and mites (Habekuss et al., 2000; Radoslav and Kutinkova, 2004).

This paper present the behaviour to fire blight and codling moth of 12 apple cultivars with different origin ('Aura', 'Rumina', 'Jonaprim', 'Rustic', 'Rebra', 'Redix', 'Orion', 'Luna', 'Rubinola', 'Topaz', 'Goldrush' and 'Crimson Crisp'), planted in ecological demonstrative plot from Genetics and Breeding Laboratory of Research Institute for Fruit Growing Pitești, Romania.

# 2. MATERIALS AND METHODS

The study was carried out in apple ecological demonstrative plots from Genetics and Breeding Laboratory of RIFG Pitesti, Romania, planted in 2009 at 3.5 m between row and 2 m between trees (3 variants in 3 replications) on a soil with high content in clay and low content in humus. The trees trained as spindle crown, were grown under drip irrigation conditions.

In 2023, when the observations and determinations were made, the average temperature was  $12.3^{\circ}$ C being with  $2.2^{\circ}$ C higher than the normal average temperature of area, the maximum temperature was  $36.0^{\circ}$ C with  $2.8^{\circ}$ C lower than the normal of zone, minimum temperature was  $-11.4^{\circ}$ C with  $13.0^{\circ}$ C higher than the normal minimum temperature and the precipitation was 562.8 mm with 99.8 mm lower than the multiannual average rainfall (Table 1).

Meteorological		Interval	Monthly values									Annual			
parameters				2023								values			
			Ι	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
	Monthly	2023	4.0	2.6	7.1	9.7	15.1	<i>19.4</i>	23.2	23.3	19.4	13.5	6.7	3.1	12.3
temperature •C	average	1969-'22	-1.1	0.6	5.0	10.4	15.4	19.0	20.8	20.2	15.6	10.1	4.7	0.4	10.1
	Maximum	2023	8.2	9.2	14.0	15.9	21.7	26.0	31.0	31.4	28.2	23.0	12.2	9.4	19.2
	average	1969-'22	4.4	6.2	11.2	17.0	22.2	25.9	28.1	27.9	23.3	17.2	10.5	5.5	16.6
	Minimum	2023	0.8	-3.0	1.1	4.1	9.3	13.8	16.0	<i>16.1</i>	12.4	6.3	1.8	-1.1	6.5
	average	1969-'22	-5.1	-3.7	-0.1	4.5	9.3	12.8	14.3	13.9	9.8	5.0	0.6	-3.2	4.8
	Absolute	2023	20.3	19.6	21.7	21.3	27.1	32.6	35.2	36.0	32.1	<i>29.5</i>	20.3	19.6	36.0
	daily	1969-'22	19.4	22.3	25.5	29.0	33.7	36.5	38.8	38.2	34.7	30.8	26.3	21.0	38.8
1 <i>ir</i>	maximum														
7	Absolute	2023	-4.2	-11.4	-5.7	-1.0	3.9	9.7	8.9	9.8	8.2	-0.8	-5.7	-4.8	-11.4
	daily	1969-'22	-24.4	-23.4	-19.8	-6.0	-0.5	3.5	5.5	2.2	-2.8	-7.2	-15.4	-21.2	-24.4
	minimum														
Precipitation		2023	101,7	7.9	18.8	80.4	77.4	78.7	77.7	17.0	26.1	4.9	53.8	18.4	562.8
( <i>mm</i> )		1969-'22	33.2	31.4	37.1	55.6	79.9	<i>98.4</i>	78.1	61.1	52.6	46.3	45.3	43.5	662.6

 Table 1. Values of the main average meteorological parameters of the interval 1.1.2023 – 31.XII.2023, compared with normal (1969 - 2022), Mărăcineni - Argeş

As biological material, 12 apple cultivars with different origin ('Aura', 'Rumina', 'Jonaprim', 'Rustic', 'Rebra', 'Redix', 'Orion', 'Luna', 'Rubinola', 'Topaz', 'Goldrush' and 'Crimson Crisp') were studied. Given that the cultivars studied are genetically resistant to scab, observations were made in 2023 on the fire blight (*Erwinia amylovora*) and the codling moth (*Cydia pomonella*) attacks.

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For the evaluation of the fire blight attack, both the frequency of attack on shoots (F%) and the intensity of attack (I) were recorded according to the Van der Zwet scoring scale, in which the grade "1" represents healthy shoots and the grade "10" totally destroyed shoots (Fig. 1). To prevent bacterial infections, the product *Blossom protect* was used in ecological variants (2 applications during flowering period). The observations were made on short fruit formations and shoots. 100 leaves per variant from 10 control trees and 50 shoots were analyzed, differentially noting healthy organs and those affected by this pathogen. The results were expressed as a percentage of attack frequency (F%), as follows:

- F = n / N x 100 where,
- n = number of organs attacked;
- N = total number of organs observed.



Fig. 1. Evaluation scales of the fire blight attack (after Van der Zwet et al., 1970; 1979)

Apple codling moth monitoring was carried out using *AtraPOM* sex pheromone traps. In sex pheromone traps, biweekly observations shall be made on the basis of which capture shall be determined.

## **3. RESULTS AND DISCUSSIONS**

Fire blight is one oldest and most devastating disease. Under ideal conditions it can destroy a young apple orchard or nursery in a single season. In Romania, the disease was spotted first in 1991 (Marin et al., 2018).

The control of fire blight is very difficult to achieve because the application of antibiotics is abandoned, the only way to combat this disease is the creation of cultivars with genetic resistance (Kairova et al., 2023).

Under the conditions of 2023, the pressure of infection with *Erwinia amylovora* has been at its maximum limit since June, remaining at this level until the end of August.

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Of the 12 cultivars studied, the 'Topaz' cv. proved to be the most sensitive (Table 2).

At the first evaluation (in May), the attack frequency in the field treated with *Blossom Protect* was 8.25% on short fruiting shoots, respectively 0.08% on shoots, compared to the standard filed (untreated) (F = 20.55%/short fruiting shoots, respectively F = 0.24%/shoots).

At the second evaluation (in June), the attack frequency in the field treated with *Blossom Protect* was 5.73% on shoots, compared to the standard filed (untreated) (F = 7.10%/shoots).

Also, the cultivars 'Crimson Crisp', 'Aura', 'Rubinola' and 'Jonaprim' were more susceptible, the frequency of fire blight attack being over 2.5% in the treated variants.

Cultivar	Attack frequency	Attack frequency/tree (%) Second evaluation: 30.06.2023			
Cuttvur	Short fruiting shoots	Shoots	Shoots		
Aura	5.30	0.07	4.55		
Rumina	0.20	0.02	0.05		
Jonaprim	2.50	0.02	0.15		
Rebra	0.26	0.01	0.06		
Rustic	0.30	0.02	0.30		
Redix	1.15	0.03	0.90		
Orion	0.30	0.01	0.28		
Luna	0.30	0.01	0.25		
Rubinola	4.20	0.07	4.15		
Topaz	8.25	0.08	5.73		
Goldrush	0.20	0.01	0.05		
Crimson Crisp	6.75	0.08	5.25		
Standard variant (untreated)	20.55	0.24	7.10		

Table 2. Frequency of Erwinia amylovora attack at cultivars studied

Marin et al. (2018) reported the same results regarding the attack frequency of fire blight for 'Topaz' and 'Crimson Crisp' cvs.

The codling moth (*Cydia pomonella* L.) is a very frequent pest in apple orchards all over the world, the biology of this insect being influenced by the geographical area, the changing climatic conditions and the host (Franck and Timm, 2009).

In the climatic conditions of RIFG Pitesti-Maracineni, *Cydia pomonella* develops two or even three generations per year.

For monitoring the pest *Cydia pomonella*, *AtraPOM* pheromone traps were used, the recorded data being the basis for drawing up the flight curve (Fig. 2).

In the conditions of 2023, the first catch of *Cydia pomonella* was recorded in the end of April. During the growing season there were 2 flight maximums in April and July (Fig. 2).

Control of the pest was carried out by direct control - the method of mass capture of males. With this method, mating is avoided, resulting in population collapse and, through repetition, progressive reduction of the biological reserve of the pest below the damage threshold.

In the experimental plot that has an average biological reserve, 20 pheromone traps with AtraPOM, evenly distributed, were placed.

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Fig. 2. Dynamics of adult of codling moth - Cydia pomonella (Butterflies/trap/week - number)

In the case of the first generation (G1) of the codling moth - *Cydia pomonella*, the attack frequency was between 0.0-0.4%, depending on the cultivar, compared to the untreated control where the frequency was 20.2% (Table 2).

In the case of the second generation (G2) of the pest, the attack frequency at the studied cultivars was between 0.2-0.5% compared to the untreated control where the frequency was 33% (Table 3). Balint et al. (2013) reported that the codling moth damages were significantly correlated with seed number in fruits throughout the whole vegetation period. In our study the higher attack frequency was registered at 'Topaz' cv. (0.4) which had a high number of seeds in the fruit (10-12 seeds/fruit).

Variant/Cultivar	Number of fruits analyzed	Number of fruits attacked	Attack frequency (F%)	
Aura	1,000	2	0.2	
Rumina	1,000	0	0,0	
Jonaprim	1,000	2	0.2	
Rebra	1,000	2	0.2	
Rustic	1,000	1	0,1	
Redix	1,000	3	0.3	
Orion	1,000	1	0.1	
Luna	1,000	1	0.1	
Rubinola	1,000	0	0.0	
Topaz	1,000	4	0.4	
Goldrush	1,000	0	0.0	
Crimson Crisp	1,000	0	0.0	
Chemical standard	1,000	0	0.0	
Control untreated	1,000	202	20.2	

 Table 2. Attack frequency of codling moth (first generation)

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Variant/Cultivar	Number of fruits analyzed	Number of fruits attacked	Attack frequency (F%)		
Aura	1,000	2	0.2		
Rumina	1,000	0	0.0		
Jonaprim	1,000	3	0,3		
Rebra	1,000	2	0.2		
Rustic	1,000	2	0.2		
Redix	1,000	4	0.4		
Orion	1,000	2	0.2		
Luna	1,000	1	0.1		
Rubinola	1,000	0	0.0		
Topaz	1,000	5	0.5		
Goldrush	1,000	0	0.0		
Crimson Crisp	1,000	0	0.0		
Chemical standard	1,000	0	0.0		
Control untreated	1,000	330	33.0		

### Table 3. Attack frequency of codling moth (second generation)

## 4. CONCLUSIONS

Regarding the fire blight attack, the 'Topaz' cv. proved to be the most sensitive, the frequency of attack in the lot treated with *Blossom Protect* being 8.25% on short fruiting shoots and 0.08% on shoots, much smaller compared to the group standard (F=20.55% on short fruiting formations, 0.24% on shoots).

The control of fire blight is very difficult to achieve because the application of antibiotics is abandoned. In order to better manage the fire blight attack, breeding of new tolerant or resistant apple cultivars is always actual and a constant request.

The pheromone traps *AtraPom* were used for control of codling moth. In the first generation, the frequency of the attack was between 0.0-0.4% depending on the cultivar, compared to the untreated variant where the frequency was 20.2%. In the second generation the frequency of the attack was between 0.0-0.5% compared to the untreated variant where the frequency was 33%.

With this method, mating is avoided, resulting in population collapse and, through repetition, progressive reduction of the biological reserve of the codling moth below the damage threshold.

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