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LUCRĂRI ŞTIINŢIFICE SERIA HORTICULTURĂ, 60 (2) / 2017, USAMV IAŞI

BEHAVIOR OF SOME NEW APPLE VARIETIES ON THE FIREBLIGHT ATTACK

COMPORTAREA UNOR SOIURI NOI DE MĂR LA ATACUL FOCULUI BACTERIAN

MARIN F. C. [1]***, CĂLINESCU Mirela, MILITARU Mădălina, SUMEDREA Mihaela, SUMEDREA D.***
e-mail: c_marin69@yahoo.com

Abstract. *Fireblight - Erwinia amylovora Burill. Winslow is one of the most damaging for the apple culture in the many apple producing countries. Under ideal microclimate conditions it can destroy a young apple orchard in a single growing season, and by consequence it is very devastating not only for the apple production growing industry but for nurseries sector as well. In order to restrain and control the disease spread and damages, intensive researches are carried out in many fruit growing countries. This work aim was to assess the infection risks and early warning possibilities for the fire blight infections, under specific climatic conditions, using modern computer software, to assess the behavior of some new released and introduced apple varieties and to establish their susceptibility to natural occurred infections on active growing lateral shoots, in the latest years. According to the software forecast model, in the latest years, the infection risk with Erwinia amylovora on apples was high and very high from May to October. Under the given natural and technological conditions, the most sensitive apple varieties to fireblight attack were: Auriu de Bistrita (ROM) DD%=45.0; Dalinco and Dalinred (FRA) DD%=30-45.0; Topaz (CEH) DD%=35.0; Crimson Crisp and Idared (USA) DD%=35.0; Red Jonaprince (NL), Fuji Kiku Clone 8 (JPN) DD%=15.0. During the identified risk periods the apple trees need special prunings and preventive treatments with plant protection products including copper hydroxide and fosetil-aluminium, to keep them in good phytosanitary status. In order to better manage the fireblight disease, breeding o new tolerant or resistant apple varieties is always actual and a constant request*.
Key words: apple, varieties, fireblight, behavior, monitoring, early-warning

Rezumat. *Focul bacterian al rozaceelor - Erwinia amylovora Burill. Winslow este una dintre cele mai pagubitoare maladii care afectează cultura mărului în numeroase tări ale lumii. In condiţii ideale de microclimat poate distruge o plantaţie tânară in decursul unui sezon de vegetaţie, de aceea este păgubitoare nu numai pentru producţia de mere ci şi pentru sectorul pepinieristic. Pentru restrângerea şi controlul răspândirii maladiei şi a daunelor, se intreprind cercetări laborioase în multe ţări cu tradiţie în pomicultură. Scopul acestei lucrări a fost acela al investigării riscului infecţiilor cu focul bacterian, şi al posibilităţilor de avertizare timpurie a atacului, in condiţii climatice specifice, folosind sofware modern, evaluarea comportării unor soiuri de măr recent omologate sau introduse în ţară şi stabilirea susceptibilităţii la infecţiile*

[1]Research Institute for Fruit Growing Pitesti Romania, Orchard Technology and Plant Protection Lab

apărute în condiţii naturale pe lăstarii laterali. Conform modelului software de avertizare timpurie,in ultimii ani riscul infecţiilor cu Erwinia amylovora a fost mare şi foarte mare din Mai şi până în Octombrie. În condiţiile naturale şi tehnologice de referinţă, cele mai susceptibile soiuri de măr s-au dovedit a fi : Auriu de Bistrita (ROM) GA%=45.0; Dalinco and Dalinred (FRA) GA%=30-45.0; Topaz (CEH) GA%=35.0; Crimson Crisp and Idared (USA) GA%=35.0; Red Jonaprince (NL), Fuji Kiku Clone 8 (JPN) GA%=15.0. Pe parcursul perioadelor de risc identificate, pomii au avut nevoie de tăieri speciale şi tratamente preventive cu produse de protecţie a plantelor pe bază de hidroxid de cupru şi fosetil de aluminiu pentru a putea fi menţinuţi în stare fitosanitară corespunzătoare. Pentru prevenirea şi combaterea cu success a focului bacterian, ameliorarea sortimentală şi obţinerea de soiuri de măr tolerante sau rezistente este o cerinţă şi o activitate mereu actuală.

Cuvinte cheie: măr, soiuri, focul bacterian, comportare, monitoring, avertizare-timpurie

INTRODUCTION

Fireblight is one of the most damaging for the apple culture in many apples producing countries. Under ideal conditions it can destroy a young apple orchard in a single growing season, and by consequence it is very devastating not only for the apple production growing industry but for nurseries sector as well (Biggs *et al.,* 2008; Babadoost, 2005; Hartman and Hershman, 2002; Ritchie and Sutton, 2002; Branişte and Amzăr, 2000; Amzăr and Ivaşcu, 2003; Tomşa and Tomşa, 2003). The causal agent (*Erwinia amylovora* Burr Winslow, *Bacteriophyta, Enterobacteriaceae*) was spotted for the first in England in the 18th Century, but nowadays is present in many apple growing countries. More over the pathogen attacks 75 hosts plant species and genera, on many genus of fruit species (*Aronia, Fragaria, Cydonia, Cerasus, Malus, Pyrus, Rubus, Sorbus*), and many decorative species as well. In Romania the damaging agent was spotted first in 1991 (Amzăr *et al.,* 2003). The pathogen overwinters in diseased shoots and surrounding bark plagues, during the vegetation period the bacteria are spread on host plants by bees, insects, birds, winds, rains water and human interventions (Biggs and Steiner, 2000).

The symptoms can develop in an exponential manner, secondary infection symptoms can be worse than those in the primary infections. In the susceptible cultivars the amount of fire blight disease depends on: the number and distribution of sources from which inoculum is available; the genetic susceptibility of scion and rootstock cultivars; the rate at which new infections occur. Direct connection is between the primary sources for fire blight, the amount of disease in the previous year and the phytosanitary procedures applied in the previous year and the actual year (Biggs *et al.*, 2008).

In order to restrain and control the disease spread and damages intensive researches are carried out in many fruit growing countries like: USA, Canada, Australia, New Zeeland, UK, Germany, Italy, Belarus and Romania in the fields of pathogen biology and epidemiology, early detection and risk assessment methods, monitoring of pathogen propagation into the ecosystems, agronomical

methods to reduce the varieties susceptibilities, use of adequate plant protection products, define behavior on the pathogen attack and breeding of tolerant or tolerant varieties.

This work aim was to assess the infection risks and early warning possibilities for the fire blight infections, under specific climatic conditions, using modern computer software Specware Pro 9, to assess the behavior of some new released and introduced apple varieties and to establish their susceptibility to natural infections occurred on active growing lateral shoots, in the latest years.

MATERIAL AND METHOD

The researches were conducted during 2016-2017, at Research Institute for Fruit Growing Pitesti Romania. The weather data were collected using the WatchDog Spectrum Technologies Inc. semi-automate weather station and were stored, processed and analyzed using the facilities of the MS Office Excel 2010 and with SpecWare Pro 9.0 software facilities for early warning. The studied biological material consisted in 42 apple varieties recently released or introduced in our Country, grafted on six different low vigor vegetative rootstocks, grown in an remote and isolated high density intensive orchard, with over 3000 trees/ha, trained as slender spindles and supplied with water and nutrients by fert-irrigation. The experimental device, was located on a plane terrain situated on the second terrace of the Argeş River, on a low to medium fertile illuvial-clay soil unit (over 30% 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 /100g). Soil reaction is slightly acid (pH 5.8-6.8). The orchard floor was covered with grass between the trees rows and cleared with total herbicides on stripes of 1.0-1.2 m wide, along the trees rows. The fireblight infection risk was assessed using Cougar scale (where '0'=very low infection risk; '4'=very high infection risk), and the apple varieties behavior during the vegetation seasons was assessed using the Van der Zweet *et al.,* 1979, scale (where '1'=healthy tree; '9'=dead tree). The new apple varieties were characterized using both pomological descriptors and IPBGR descriptors for apple.

RESULTS AND DISCUSIONS

On highly sensitive apple varieties, the malady can affect all the vegetative and generative organs of the apple trees, the inoculum surviving in diseased bark cankers.

The most vulnerable periods to the pathogen infections are the blooming time and the vegetative shoots elongation. The most sensitive organs are the flower clusters, on which, the infections may become visible after 5-6 up to 30 days with higher temperatures (103 degrees over the 12.7ºC treshold). After the flowers clusters, the young vegetative shoots are the most sensitive. According Steiner, 2000, the carbohidrates reserves accumulated in the seccond part of June favorises the pathogen attack. The infections occurs, develops and became vizible very quick, less than 167 days with temperatures higher than 13.0 ºC and ooze droplets might be seen.

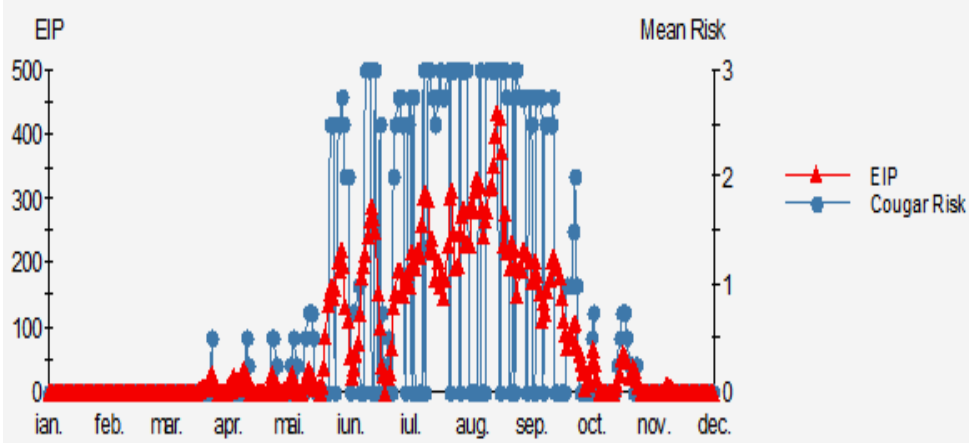

Fig. 1 Fireblight infections risk Pitesti-Maracineni, Romania, 2016

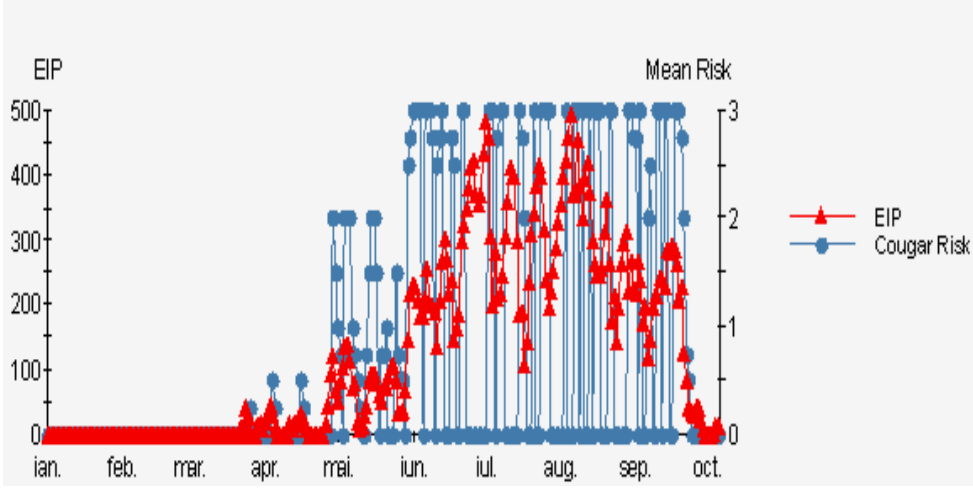

Fig. 2 Fireblight infections risk Pitesti-Maracineni, Romania 2017

Assessment of the figures 1 and 2 reveals that according to the forecast model, the infection risk with fireblight on apples was high and very high.

So, between May and October 2016, the epiphytic infection potential (EIP) was 200-300 and between May and October 2017 was 250-450.

Evaluation of Cougar infection risk shows that between May and October 2016, and between June and October 2017 the indicator was 2.0-3.0 (high and very high risk of infection).

Terefore special prunings and preventive treatments with plant protection products including copper hydroxide and fosetil-aluminium, to keep them in good phytosanitary status.

Table 1

Behavior of some apples varieties on fireblight *Erwinia amylovora* Burill Winslow attack on shoots
Research Institute for Fruit Growing Pitesti Romania 2016-2017

No	Variety and rootstock	Origin	Age	Van der Zweet scale [1-9]	Disease severity [%]	Disease incidence [%]	Damages degree [%]
1	Aura / M9	ROM	10	1	0.0	0.0	0.00
2	Auriu de Bistrita / M9	ROM	12	7	5.0	9.0	**45.00**
3	Bistritean / M9	ROM	10	1	0.0	0.0	0.00
4	Ciprian / M9	ROM	10	1	0.0	0.0	0.00
5	Florina / M9	ROM	12	2	1.0	2.0	2.00
6	Goldprim / M9	ROM	10	1	0.0	0.0	0.00
7	Initial / M9	ROM	10	1	0.0	0.0	0.00
8	Jonaprim / M9	ROM	10	1	0.0	0.0	0.00
9	Rebra / M9	ROM	12	1	0.0	0.0	0.00
10	Redix / M106	ROM	12	1	0.0	0.0	0.00
11	Romus 3 / M9	ROM	10	1	0.0	0.0	0.00
12	Romus 4 / M9	ROM	10	1	0.0	0.0	0.00
13	Romus 5 / M9	ROM	10	3	3.0	2.0	6.00
14	Rustic / M9	ROM	10	1	0.0	0.0	0.00
15	Starkprim/M9	ROM	10	1	0.0	0.0	0.00
16	Dalinbel / EMLA	FRA	8	3	2.0	5.0	10.00
17	Dalinco / EMLA	FRA	8	7	9.0	5.0	**45.00**
18	Dalinred / EMLA	FRA	8	6	8.0	5.0	**40.00**
19	Dalinred / PI 80	FRA	8	5	6.0	5.0	**30.00**
20	Dalinred / T337	FRA	8	6	0.0	5.0	0.00
21	Ariane / M9	GER	12	1	2.0	0.0	0.00
22	Ariwa / T337	GER	12	2	0.0	2.0	0.00
23	Pinova / M9	GER	12	1	0.0	0.0	0.00
24	Red Jonaprince / M9	NL	12	4	3.0	5.0	**15.00**
25	Topaz / M9	CEH	12	6	5.0	7.0	**35.00**
26	Golden Lassa / T337	ITA	12	1	0.0	0.0	0.00
27	Golden Orange / T337	ITA	12	3	2.0	3.0	6.00
28	Fuji Kiku Clone 8 / M9	JPN	12	4	5.0	3.0	**15.00**

29	Enterprise / M9	USA	12	1	0.0	0.0	0.00
30	Crimson Crisp / Pajam 1	USA	8	4	3.0	5.0	**15.00**
31	Crimson Crisp / PI 80	USA	8	5	5.0	4.0	**20.00**
32	Golden Delicious / M9	USA	12	3	2.0	5.0	10.00
33	Goldrush / Pajam	USA	8	1	0.0	0.0	0.00
34	Goldrush / PI 80	USA	8	1	0.0	0.0	0.00
35	Goldrush / EMLA	USA	8	3	2.0	5.0	10.00
36	Idared / M9	USA	12	3	5.0	4.0	**20.00**
37	Jonatan / M9	USA	12	3	2.0	5.0	10.00
38	Nured Jonathan / M9	USA	12	2	5.0	1.0	5.00
39	Prima / M9	USA	12	1	0.0	0.0	0.00
40	Braeburn / M9	NZ	12	2	2.0	5.0	10.00
41	Hillwell / M9	NZ	10	2	3.0	3.0	9.00
42	Falstaff / M9	UK	10	1	0.0	0.0	0.00
Indicators		***AVG***		**2.5**	**1.90**	**2.26**	**8.52**
		STDEV		1.8773	2.4376	2.5285	12.9544
		VAR		75.0934	127.9744	111.7849	151.9790

Evaluation of the table 1 brings new data on the behavior 42 apple cultivars on the lateral shoots to the fireblight attack during the study period 2016-2017.

The Romanian apple varieties displayed a good behavior to the pathogen attack on lateral shoots, only four of them (28.57%) being affected. The most damaged variety was Auriu de Bistrita / M9 with an average damage degree DD%=45.0, followed by Romus 5 with DD%=6.0.

During the two years of study sever affected were the French apple varieties Dalinco /EMLA and Dalinred / EMLA and Dalinred /PI 80, with the average damage degree DD%=45.0, 40.0 and respectively 30.0 followed by Czech variety Topaz / M9 with DD%=35.0.

Under the given conditions, the American eleven apple varieties had a good behavior to the pathogen attack, only two of them (18.18%) were affected Crimson Crisp / PI 80 and Idared / M9 with an average damage degree DD%=20.0.

Among the German and Dutch varieties, the most affected was Red Jonaprince / M9 variety with the average damage degree DD%=15.0. The same behavior had the Japanese variety Fuji Kiku Clone 8, with an average damage degree DD%=15.0 (fig.3, fig.4).

Fig. 3 Apple trees shoots attacked by fireblight *Erwinia amylovora* Burill. Winslow

Fig. 4 Fruits from well trained and healthy apple trees tolerant on *Erwinia amylovora* Burill. Winslow

CONCLUSIONS

1. The most vulnerable periods to the fireblight - *Erwinia amylovora* Burill Winslow infections are the blooming time and the young vegetative shoots elongation.

2. The facilities of the WatchDog semi-automate weather station and the dedicate software Specware Pro 9.0 are very useful tools for monitoring the risk with fireblight infections, early warning and precise positioning of the preventive phytosanitary treatments.

3. The biological material assessment under the orchard condition is very important for complete evaluation of the varieties, prior their extension into intensive fruit production system.

4. Under the given natural and technological conditions, the most sensitive apple varieties to fireblight attack were: Auriu de Bistrita (ROM), Dalinco and Dalinred (FRA), Topaz (CEH), Crimson Crisp and Idared (USA), Red Jonaprince (NL), Fuji Kiku Clone 8 (JPN). Therefore, during the risk periods they needed special prunings and preventive treatments with plant protection products including copper hydroxide and phosetil-aluninium, to keep them in good phytosanitary status.

5. In order to better manage the fireblight attack, breeding o new tolerant or resistant apple varieties is always actual and a constant request.

Aknowledgements: *This research was possible with the support of the Agriculture Ministry, Research Program ADER and Research Institute for Fruit Growing Pitesti Romania.*

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