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Susceptibility of Some Walnut Cultivars to *Gnomonia leptostyla* and *Xanthomonas arboricola* pv. *juglandis* in Bulgaria

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Abstract

The aim of the present research was to study and compare the susceptibility of 13 walnut cultivars – 5 Bulgarian (B), 3 French (F), 2 Hungarian (H), and 3 American (A) – to *Gnomonia leptostyla* (Fr.) and *Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye, the pathogens causing leaf spot and walnut blight. The study was conducted under natural environmental conditions in a 5-8-year-old walnut collection orchard of the Fruit Growing Institute – Plovdiv, during the period 2006-2010. The evaluation of the attack produced by these pathogens was carried out on different organs leaves and nuts in two periods of the year (June and October). All the studied cultivars were distributed in 6 different levels of susceptibility to a given pathogen based on the degree of attack. The article presents data on the sensitivity of the studied walnut cultivars to the attack to *G. leptostyla* (Fr.) and X. *arboricola* pv. *juglandis* (Pierce) Dye and discusses the results obtained.

Key words: Juglans regia, cultivars, leaf spot, walnut blight, infection

Introduction

The English (Persian) walnut (*Juglans regia* L., *Juglans andaceae*) is attacked by great number of diseases. Among all known walnut diseases

at present the greatest economic importance in the climatic conditions in Bulgaria have walnut bacterial blight, caused by *Xanthomonas arboricola pv. juglandis* (Xaj), and walnut anthracnose, caused by a fungus which has two forms – sexual *Gnomonia leptostyla* (Fr.) Ces. et de Not.) and asexual (*Marssonina juglandis* (Lib.) Magn.). Both diseases attack the aboveground organs of the walnut tree. The causal agent of the anthracnose attacks mostly leaves, petioles and fruits while causal bacterium *Xanthomonas arboricola* pv. *juglandis* can infect leaves, catkins, female flowers, green branches, and nuts. Blight reduces yield and frequently lowers quality of harvested nuts.

Walnut blight was an object of many studies abroad – Miller and Bollen (1946), Mulerean and Schroth (1982), Gardan et al. (1986), Germain (1990), Germain, et al. (1990a), Belisario (1995), Martins (1996), Ninot et al. (1997), etc. Quite a lot data could be found in literature about the different degree of susceptibility of the walnut genotypes to the causal agent of the disease.

Total resistance to walnut blight was not established in any of the studied genotypes, but some of them, especially those of the early leafing genotypes, were attacked more strongly, which was due to the spring rains that provided more favourable conditions for infection and spreading of the disease (Mulerean & Schroth, 1982; Teviotdale et al., 1985; Olson et al., 1997; Belisario et al., 1997). Investigating the interrelation between the fruiting habit of walnut trees and the walnut blight attacks, Gardan et al. (1986) concluded that the early leafing cultivars, which most often set fruits on lateral fruit shoots, were more severely infected by the causal agent of walnut blight.

The walnut anthracnose was also an object of many studies in our country and abroad. In Bulgaria the disease was found and described for the first time by Malkov (1905, 1906) and investigated in the next years by a number of authors (Savov, 1923; Trifonov, 1962; Penev, 1964; Stefanov, 1964; Hristov, 1967, 1972; Nedev, 1976, 1983). Systematic studies on the biology, ecology and pathophysiology of its causative agent were carried out by Dimova (2003). In those studies a special attention was paid to the susceptibility of the different walnut cultivars to damages by that disease.

After some comparative research held in Hungary (Veghelyi and Penzes-Toth, 1990) and former Yugoslavia (Balaz et al., 1991) it was found that none of the investigated walnut cultivars appear to be resistant to the causal agent of anthracnose, and most of the genotypes demonstrate middle to high level of susceptibility. In similar experiments in Italy

Belisario et al. (1997) establishes that cultivars `Franquette` and `Hartley` display high level of stability to antharcnose, `Feltre` and `Malizia` - middle while `Payne`, `Serr` and `Sorrento`- low. For the climatic conditions of Spain Pastore et al. (2001) reports that the cultivars `Hartley` and `Mayette` are not attacked by the anthracnose agent while `J. Jefe` and `VZ5` show intense susceptibility to that pathogen.

The available controversial data in literature about the susceptibility of different local walnut cultivars to anthracnose as well as the lack of enough complete information about the susceptibility of some newly introduced walnut cultivars in our country was the reason to initiate that research.

The aim of the present study was to investigate and compare the susceptibility to *Gnomonia leptostyla* (*Marssonina juglandis*) and *Xanthomonas arboricola pv. Juglandis* of 13 local and introduced walnut cultivars – 3 of them American (A), 3 French (F), 2 Hungarian (H) and 5 Bulgarian (B).

Material and Methods

Susceptibility to the economically important diseases anthracnose (*Gnomonia leptostyla*) and walnut blight (*Xanthomonas arboricola pv. juglandis*) was evaluated by the infection index calculated following the formula of McKinney (1923), using collected walnut leaves and fruits. The level of *G. leptostyla* infection was detected from randomly collected 100 leaves and 50 fruits from 5 different walnut trees of each cultivar, reporting the affected tissue with developed acervuli. The attacks of *X. arboricola pv. juglandis* were reported as a percentage of the leaves and fruits infected by the bacterium. Necrotic spots of a diameter less than 3 mm were analyzed using a stereo microscope. All the studied cultivars were distributed in 6 different levels of susceptibility to a given pathogen based on the degree of attack.

Data were statistically processed by Duncan's test (Steele & Torrie, 1980).

Results and Discussion

In climatic aspect the five years of the research could be characterized as warm and moderately humid, with normal distribution of rainfall through the years. The weather in the spring months was warm and humid,

the intensity of rainfall in March was higher and in May and June lower than normal level. The summer months could be described as dry and hot (with temperatures exceeding the normal in the period June – September) and only in particular years and months the rainfall intensity was above the normal (Table 1).

Tab. 1. Climatic data registered in the Fruit Growing Institute of Plovdiv in the period 2006-2010
Klimatski podaci registrovani na Institutu za voćarstvo u Plovdivu u periodu 2006-2010

	Year *Godina*	Months *Mjeseci*							
		III	IV	V	VI	VII	VIII	IX	X
Temperature°C *Temperatura °C*	2006	7.2	12.8	17.6	21.1	22.8	23.6	18.4	13.7
	2007	8.3	12.9	18.7	23.2	25.5	23.0	-	-
	2008	9.7	13.3	17.7	22.2	24.2	24.7	-	-
	2009	6.9	12.0	19.0	22.0	24.5	23.5	18.1	13.2
	2010	7.2	12.8	18.5	21.2	24.1	25.7	19.1	-
Humidity % *Vlažnost %*	2006	80	29	74	78	74	73	76	86
	2007	76	67	78	74	58	75	-	-
	2008	74	83	76	79	64	64	-	-
	2009	78	78	75	73	68	70	80	89
	2010	78	80	76	78	78	71	74	-
Rainfall mm *Padavine mm*	2006	69	79	17	132	22	58	19	26
	2007	40	17	159	156	0	185	-	-
	2008	15	84	21	38	39	5	-	-
	2009	74	25	31	15	66	43	44	81
	2010	56	43	24	77	94	4	16	-

*****The data were collected by automatic computer system
Podaci su prikupljeni automatizovanim kompjuterskim sistemom

It is evident from the data in Table 1 that the meteorological conditions during the research period favor in a higher or lower degree the development of both diseases.

The first symptoms of anthracnose were found from the end of May to the beginning of June, when on the leaves of the trees appeared lesions, caused by the wintering stage of the fungus, *G. leptostila.* The same were found on young leaves, mainly in the form of small to medium-large round light brown spots, outlined by a dark brown band on the

periphery. On the leaves of some of the cultivars could be seen merging of the separate spots and forming of bigger ones, with irregular shape, often confined by nervation of leaves. Similar spots but of elongated oval form could be seen on the petioles of leaves and their nervation as well as on the young shoots. The spots on the fruits were small, grey-brown, on the surface.

Fig 1. Symptoms of walnut leaf spot *(Gnomonia leptostyla* (Fr.))
Simptomi antraknoze oraha (Gnomonia leptostyla (Fr.))

Walnut blight is usually manifested in two forms: continuous necrosis and local spotting. In the first case the disease is manifested as blackening of the main and side veins of the young growing leaves. When the bacterium penetrates into the closely located parenchyma tissue of the leaf, large necrotic spots are formed. Hence, the bacterium can pass through the leaf stalk into the shoot, causing the latter to wither and dry out. The local spotting appears in the old leaves as small angular brownish spots of an oily type (fig. 2).

The spots on the shoots are black, oily, slightly sunken, with longitudinal or ring shaped, affecting both the bark and the wood that turns black. The bacterium attacks the catkins and the young fruit sets, which turn black and fall off. The spots on the growing fruits are large, rounded, black, with a shiny and wrinkled surface.

Fig. 2. Symptoms of bacterial blight on the leaves *(Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye)
Simptomi bakteriozne pjegavosti oraha (*(Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye)

The rainfall during the second half of the vegetation period favored the development of the two diseases and created conditions for arising of new, secondary infections and appearance of new lesions on different green parts of the walnut trees. In such climatic conditions some research was conducted to determine the level of susceptibility of the different walnut cultivars to attacks of anthracnose and bacterial blight.

The results of the conducted research for determining the level of susceptibility of the walnut cultivars to anthracnose attack show, that all investigated cultivars are susceptible to a certain extent to attack by the agent of the disease, regardless of the fluctuation through the years (Table 2).

From the data in Table 2 it is evident that the early leafing cultivars, which most often set fruits on apical fruit shoots, re more susceptible to the causal agent, *Gnomonia leptostyla* (Fr.) Ces. et de Not, compare to later leafing cultivars and lateral fruit-bearing - a regularity which was observed through all the years of this study.

In the group of apical fruit-bearing cultivars on leaf level the highest infestation index was reported in `Seer` (41.6%), and the lowest one –

in `Silistrenski`(10.3%). In cultivars `Slivenski`,`Izvor 10`,`Sheinovo` and `Kuklenski` the degree of *G. leptostyla* infestation varied within 29.8 and 19,4 % in average. In the group of lateral fruit-bearing cultivars, in contrast to the above group, were reported considerably lower values of anthracnose attack, ranging from 13.9 to 5.2%. The highest infestation index in the leaves was reported in cultivars `Hartley` (13.9%), `Milotai` (9.0%), `Tiszacsecsi` (9.0%)` and Lara` (8.8%), and the lowest in cultivars `Fernette`(8.0), `Fernor`(7,0%) and `Chandler` (5.2%) (Table 2).

Tab. 2. Response of walnut cultivars to *G. leptostyla* attacks in the period 2006-2010, Fruit Growing Institute – Plovdiv.
Reakcija sorti oraha na patogena G. leptostyla u periodu 2006-2010, Voćarski institut - Plovdiv

Cultivar *Sorta*	Leaf infestation index, by McKinney *Indeks bolesti lista prema McKinney-u*						Fruit infestation index, by McKinney *Indeks bolesti ploda prema McKinney-u*			
	2006	2007	2008	2009	2010	Average *Prosjek*	2008	2009	2010	Average *Prosjek*
Serr	61.4	82.1	28.3	5.5	30.7	41.60 a(4)	1.50	2.20	19.5	7.73a(6)
Slivenski	45.8	49.0	31.2	6.2	17.0	29.84 b(4)	0.65	1.73	3.51	1.96b(4)
Izvor 10	50.8	39.3	31.2	5.0	16.0	28.46 b(4)	0.60	1.40	3.30	1.77b(4)
Sheynovo	47.5	30.9	15.3	3.4	12.8	21.98 bc(3)	0.50	0.65	0.50	0.55b(3)
Kuklenski	34.1	32.0	14.2	3.5	13.2	19.40 bcd(3)	0.47	1.15	2.70	1.44b(3)
Silistrenski	12.4	10.8	13.0	2.3	13.2	10.34 cde(3)	0.42	0.98	2.65	1.35b(3)
Hartley	20.4	14.5	18.0	3.0	13.4	13.86 cde(3)	0.16	0.21	0.05	0.14b(1)
Lara	15.0	13.4	5.7	1.0	8.7	8.76 cde(3)	0.05	0.06	0.10	0.07b(1)
Milotai 10	16.0	9.8	8.3	1.4	9.7	9.04 cde(3)	0.19	0.22	0.18	0.20b(1)
Tiszacsecsi	21.0	8.0	6.9	1.2	8.0	9.02 cde(3)	0	0.20	0	0.07b(1)
Fernette	29.8	1.6	0	0.1	8.4	7.98 de(3)	0.30	0	0	0.10b(1)
Fernor	10.2	9.6	4.0	0.9	10.1	6.96 de(3)	0.05	0	0.10	0.05b(1)
Chandler	8.2	3.4	5.5	0.9	7.8	5.16 e(3)	0.03	0	0.05	0.03b(1)

The means followed by the same letter do not differ significantly from one another ($p = 0.05$).
Označene vrijednosti se ne razlikuju značajno jedna od druge ($p = 0.05$).
Leaf cultivar susceptibility: (1) Highly resistant (up to 1 % infected area; (2) Resistant (1 – 5 % infected area); (3) Slightly susceptible (5 – 25 % infected area); (4) Susceptible (25 -50 % infected area); (5) Highly susceptible (50 - 75 % infected area), (6) Very highly susceptible (75 - 100 %) infected area.
***Osjetljivost lista kod sorte**: (1) Veoma otporan (do 1 % zaraženog područja; (2) Otporan (1 – 5 % zaraženog područja); (3) Neznatno osjetljiv (5 – 25 % zaraženog područja); (4) Osjetljiv (25 -50 % zaraženog područja); (5) Veoma osjetljiv (50 - 75 % zaraženog područja), (6) Izuzetno osjetljiv (75 - 100 %) zaraženog područja.*
Fruit cultivar susceptibility: (1) Highly resistant (up to 0.25% % infected area; (2) Resistant (0.25 – 0.5% infected area); (3) Slightly susceptible (0.5 – 1.5% infected area); (4) Susceptible (1.5 – 3.5% infected area); (5) Highly susceptible (3.5 – 5% infected area); (6) Very highly susceptible (> 5% infected area).
***Osjetljivost ploda kod sorte:** (1) Veoma otporan (do 0,25% zaraženog područja; (2) otporan (0,25 – 0,5% zaraženog područja); (3) Neznatno osjetljiv (0,5 – 1,5% zaraženog područja); (4) Osjetljiv (1,5 – 3,5% zaraženog područja); (5) Veoma osjetljiv (3,5 – 5% zaraženog područja); (6) Izuzetno osjetljiv (> 5% zaraženog područja).*

The results were similar at fruit level. In the group of apical fruit-bearing cultivars the highest infestation index in the fruits was reported in `Seer` (7.7%) and middle in the rest cultivars (`Slivenski`, `Izvor` 10, `Kuklenski`, `Silistrenski` and `Sheinovo` varying from 2.0 to 0.6 % (Table 2). In the group of lateral fruit-bearing cultivars a higher level of attack was reported in cultivars 'Millotay'(0.20%) and 'Hartley'(0.14%), while in the rest of the cultivars (`Lara`,`Fernette`, `Tiszacsecsi`, `Fernor` and `Chandler` it was low and varied from 0.1 to 0.03 %. (Table 2).

The investigated walnut cultivars are not attacked equally regarding the bacterial agent, *Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye, which is very well illustrated by the data in Table 3. Apical fruit-bearing cultivars, as most of Bulgarian cultivars are, demonstrate high susceptibility to anthracnose. Regarding the bacterial blight, they show some tolerance and are not so intensely attacked by this disease as lateral fruit bearing cultivars.

Tab. 3. Response of walnut leaves to *X. arboricola* pv. *juglandis* attacks in the period 2006-2010, Fruit Growing Institute – Plovdiv
Reakcija lišća oraha na patogena X. arboricola pv. juglandis u periodu 2006-2010, Voćarski institut - Plovdiv

Cultivar *Sorta*	Leaf infestation index, by McKinney *Indeks bolesti lista prema McKinney-u*						Fruit infestation index, by McKinney *Indeks bolesti ploda prema McKinney-u*			
	2006	2007	2008	2009	2010	Average *Prosjek*	2008	2009	2010	Average *Prosjek*
Serr	5.1	7.0	14.7	0.5	1.0	5.66 bc(2)	0.5	1.0	1.0	0.83 e(3)
Slivenski	3.9	5.3	20.1	4.5	2.0	7.16 bc(2)	4.0	4.5	2.0	3.50 bc(5)
Izvor 10	4.0	8.2	27.8	1.8	2.0	8.76 bc(2)	1.8	1.0	2.0	1.60 cde(4)
Sheynovo	1.1	4.9	18.6	1.3	1.0	5.38 bc(2)	1.3	1.0	1.0	1.10 de(3)
Kuklenski	5.3	7.8	23.0	3.8	5.0	8.98 bc(3)	4.6	3.8	5.0	4.47 ab(5)
Silistrenski	2.3	7.8	14.8	0.6	1.5	5.40 bc(2)	3.7	0.3	1.0	1.67 cde(4)
Hartley	15.8	21.9	22.2	7.6	13.4	16.18 a(3)	7.6	4.0	6.5	6.03 a(5)
Lara	4.3	7.8	10.4	3.0	5.0	7.50 bc(2)	2.5	1.0	1.3	1.60 cde(4)
Milotai 10	3.6	4.1	9.1	6.0	10.0	6.56 bc(2)	1.8	6.0	10.0	5.93 a(5)
Tiszacsecsi	2.0	6.4	15.3	5.8	8.0	7.50 bc(2)	3.1	1.2	3.0	2.43 bcd(4)
Fernette	3.6	2.8	10.2	0.9	2.5	4.00 c(2)	0.9	0.1	1.0	0.67 e(3)
Fernor	0.7	1.3	8.1	2.8	4.0	3.38 c(2)	1.6	0.3	1.2	1.03 de(3)
Chandler	3.7	4.6	3.5	2.5	7.0	3.66 c(2)	1.4	0.5	1.3	1.07 de(3)

The means followed by the same letter do not differ significantly from one another ($p = 0.05$).
Označene vrijednosti se ne razlikuju značajno jedna od druge (p = 0.05).
Leaf cultivar susceptibility: (1) Highly resistant (0 - 3 % infected area); (2) Resistant (3 - 10 % infected area); (3) Slightly susceptible (10 - 25 % infected area); (4) Susceptible (25 - 50 % infected area); (5) Highly susceptible (50 - 75 % infected area), (6) Very highly susceptible (75 - 100 % infected area).
Osjetljivost lista kod sorte: *(1) Veoma otporan (0 - 3 % zaraženog područja); (2) Otporan (3 - 10 % zaraženog područja); (3) Neznatno osjetljiv (10 - 25 % zaraženog područja); (4) Osjetljiv (25 - 50 % zaraženog područja); (5) Veoma osjetljiv (50 - 75 % zaraženog područja), (6) Izuzetno osjetljiv (75 - 100 % zaraženog područja).*
Fruit cultivar susceptibility: (1) Highly resistant (up to 0.25% % infected area; (2) Resistant (0.25 – 0.5% infected area); (3) Slightly susceptible (0.5 – 1.5% infected area); (4) Susceptible (1.5 – 3.5% infected area); (5) Highly susceptible (3.5 – 5% infected area); (6) Very highly susceptible (> 5% infected area).
Osjetljivost ploda kod sorte*: (1) Veoma otporan (do 0.25% % zaraženog područja; (2) Otporan (0.25 – 0.5% zaraženog područja); (3) Neznatno osjetljiv (0.5 – 1.5% zaraženog područja); (4) Osjetljiv (1.5 – 3.5% zaraženog područja); (5) Veoma osjetljiv (3.5 – 5% zaraženog područja); (6) Izuzetno osjetljiv (> 5% infected area).*

In the group of apical fruit-bearing cultivars on leaf level, the highest infestation index was reported in cultivars `Kuklenski`(9.0%), `Izvor` 10`(8.8%) and `Slivenski`(7.2%), and considerably lower in the rest of the cultivars like `Sheinovo`(5.4%), `Silistrenski` (5.4%) and `Silistrenski` (5.7%), (Table 3).

In the group of lateral fruit-bearing cultivars, the highest level of attack was reported in `Hartley`(16.2%) and `Lara`(11.0%), middle – in `Tiszacsecsi` (7,5 %) and `Millotay`(5.6 %) and low – in `Chandler`(4.4%), `Fernette`(4.0%) and `Fernor`(3.4%) (Table 3).

The results at level fruit were similar. In apical fruit-bearing cultivars, the average level of attack is reported for cultivars `Kuklenski`(4.5%) and `Slivenski` (3.5%), and low level of attack for `Silistrenski`, `Izvor` 10, `Sheinovo` and `Seer`, varying from 1,7% to 0.8%. For cultivars of lateral fruit-bearing the highest level was reported for `Hartley` (6.0%), and `Millotay` (5.9%), middle for `Tiszacsecsi`(2.4%) and `Lara` (1.6%) and the lowest for `Chandler` (1.1%), `Fernor`(1.0%) and `Fernette` (0.7%) (Table 3).

Conclusion

Summarizing the results of the research, we can make the conclusion that all investigated cultivars are susceptible to attack of walnut anthracnose and walnut bacterial blight agents to some extent.

Cultivars of apical fruit-bearing are more susceptible to anthracnose attack compare to cultivars of lateral fruit-bearing. The cultivars of apical fruit-bearing and earlier leafing are more susceptible to anthracnose attack compare to those of the same type of fruit-bearing and later leafing. From the group of apical fruit-bearing cultivars the most sensitive to anthracnose are `Seer`, `Slivenski` and `Izvor` 10, and the less sensitive - `Silistrenski` and `Sheinovo`. The cultivar `Kuklenski` takes a middle position. For lateral fruit-bearing walnut cultivars a more intense attack of anthracnose is observed in cultivars with earlier leafing compare to those of the same type of fruit-bearing but with later development. The most susceptible of this group are cultivars `Hartley`, `Lara`, `Tiszacsecsi` and `Millotay`, and the least susceptible are `Chandler` `Fernor` and `Fernette`.

The cultivars of lateral type of fruit-bearing are more susceptible to bacterial blight attack compare to those of apical fruit-bearing. From the apical fruit-bearing cultivars more susceptible to bacterial blight at level leaves and fruits are cultivars `Kuklenski`, `Slivenski` and `Izvor 10`, while

`Silistrenski` and `Sheinovo` are with low degree of sensitivity. The cultivars of lateral type of fruit-bearing and earlier leafing are more susceptible to bacterial blight attack compare to those of the same type of fruit-bearing and later development. In this group the most sensitive at leaf level is are cultivar `Hartley`, followed by cultivars `Lara`,`Tiszacsecsi`, and `Millotay`, and the least sensitive - `Chandler`, `Fernor` and `Fernette`.

At fruit level the most sensitive to this disease are cultivars `Hartley` and `Millotay`, followed by cultivars `Tiszacsecsi`, and `Lara`, and the least sensitive - `Chandler`, `Fernor` and `Fernette`.

In conclusion we must note the fact that in conditions of Bulgaria, respectively the region of Plovdiv, anthracnose occurs more often. It is observed every year and causes serious damages on the green organs of walnut trees (Arnaoudov & Gandev, 2009). The cultivars of earlier development and apical fruit-bearing, to which almost all Bulgarian cultivars belong to, are more susceptible to anthracnose compare to those of lateral type of fruit-bearing and later development.

Bacterial blight on walnuts in Bulgaria is spread on a smaller scale. Most probably, on one hand, this is due to the lower sensitivity of the popular walnut cultivars and genotypes and on the other hand – the geographical position and climatic conditions of the region. From the point of view of the local walnut cultivars, this disease could cause big damage only in regions and years with higher humidity. Regarding the introduced walnut cultivars of lateral fruit-bearing type, the situation is different. For some of them it has been ascertained in this, as well as in previous our research (Arnaoudov at al., 2009), that they are highly sensitive to bacterial blight attack. This makes it necessary when planting new orchards in future to make the right choice, assuming not only the economic characteristics of the cultivar but its sensitivity to economically important diseases, as well.

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Osjetljivost nekih sorti oraha na patogene *Gnomonia leptostyla* i *Xanthomonas arboricola* pv. *juglandis* u Bugarskoj

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Sažetak

Cilj ovog istraživanja bio je da se prouči i uporedi osjetljivost 13 sorti oraha – 5 bugarskih (B), 3 francuske (F), 2 mađarske (H), and 3 američke (A) – na *Gnomonia leptostyla* (Fr.) i *Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye, patogene koji prouzrokuju antraknozu oraha i bakterioznu pjegavost oraha. Ispitivanje je sprovedeno u prirodnim uslovima okruženja na kolekcionom zasadu starom od 5 do 8 godina u Voćarskom institutu u Plovdivu tokom perioda 2006-2010. Evaluacija napada kojeg su prouzrokovali ovi patogeni sprovedena je na 6 različitih nivoa osjetljivosti na dati patogen, a baziraju se na stepenu napada. Članak prezentuje podatke o osjetljivosti ispitivanih sorti na patogene *G. leptostyla* (Fr.) i X. *arboricola* pv. *juglandis* (Pierce) Dye, kao i diskusiju u vezi sa dobijenim rezultatima.

Ključne riječi: Juglans regija, sorte, antraknoza oraha, bakteriozna pjegavost oraha, infekcija

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