Scientific Papers. Series B, Horticulture. Vol. LXVII, No. 1, 2023
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

EVALUATION OF PEAR AUTOCHTONOUS GENETIC RESOURCES REGARDING BEHAVIOUR TO MAIN DISEASES AND PESTS UNDER FIELD CONDITIONS

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Abstract

In this paper we proposed to evaluate 53 pear genotypes collected in the germplasm collection of the Research Institute for Fruit Growing Pitesti, Romania regarding the behaviour to the main diseases and pests, in order to identify potential genitors for future breeding work. The evaluation was carried out between 2020 and 2022 after a scale from 1 (no symptoms) to 9 (very sensitive). The results obtained showed that there are enough sources of genes for resistance, as follows: `Cu miezul roşu`, `Anţig`, `Harbuzeşti`, `Para lui Niţă`, `Pere gutui`, `Tudor`, `Haydeea`, `Argessis`, `Romcor`, `Cristal`, `Paradise`, `Euras`, `Aniversare` cvs. for resistance/tolerance to fire blight; `Ervina`, `Romcor`, `Para lui Niţă`, `Cristal`, `Tudor`, `Mustoase`, `Paradise`, `Daciana`, `Carpica`, `Republica` cvs. for resistance/tolerance to pear scab;`Paradox`, `Corina`, `Pepenii`, `Haydeea`, `Argessis`, `Untoasă de Târgu Mureş`, `Isadora` - for the resistance/tolerance to Psylla. Some of these cultivars (`Cu miezul roşu`, `Isadora`, `Monica`, `Haydeea`, `Ervina`, `Cristal`, `Euras`, `Paradise`) have already been introduced into artificial hybridization carried out in the last years.

Key words*: breeding, Erwinia amylovora, Psylla sp., Pyrus, resistance, Venturia pyrina.*

INTRODUCTION

The pears are cultivated today in all continents, both in the northern hemisphere and in the southern hemisphere, totaling a production of over 25 metric million tons in 2021 (FAOSTAT, 2023). The genus *Pyrus* has at least 22 known species, all of which are native to Asia, Europe and the northern areas of the United States (Bell et al., 1996).

Disease and pests resistance is very important objective to most pear breeders. Numerous programs to improve the pears that are ongoing throughout the world have as main objective the increase in fire blight resistance (the eastern and southern parts of North America, and many regions of Europe), also to pears *Psylla* (*Cacopsylla pyricola* Foerster) and scab (*Venturia pirina* Aderhold). Along with fire blight, *Psylla* is responsible, in large part, for the decline of pear orchard (Alonso et. al., 2007). In Europe the most pear varieties are come from *Pyrus communis*, also, in Romania. The worldwide production of pears is dependent on relatively few cultivars, the reduction of the number of varieties that are planted, as a result of the demand of the market, causes progressive erosion in the genetic heritage of the pear varieties.

In our country, the pear breeding programs provides the creation of a valuable assortment adapted to the local climatic conditions, superior quality and resistance /tolerance to diseases and pests. The main aim of these research programs were the conservation and evaluation of pear genetic resources and the diversification of disease and pests resistance sources.

The fire blight caused by the bacteria *Erwinia amylovora* (Burrill) is the most dangerous disease of the pear culture, and, in Romania, it remains one of the limiting factors of the pear culture. The attack of these bacteria manifests itself on flowers, fruits, stems, especially young ladders, to which a typical symptom appears, bending in the form of a stick, on which the dried leaves remain hanged. Combating the fungus through phytosanitary treatments is expensive and does not always work, most of

the time the infected plantations must be cleared.

Most varieties from *Pyrus communis* are sensitive to *Erwinia amylovora*, among them are very valuable, such as: 'Williams', 'Clapp's Favorite', 'Comice', 'Anjou', 'Aurora' (van der Zwet, 1982, Thibault, B., 1983). Less than 5% of the pear varieties have a resistance appreciated as moderate, among the moderately resistant varieties are Seckel and Kieffer Sedling (Bell, 1990). Some of Romanian local varieties, such as: 'Decana Krier', 'Galbene', 'Pere de iarnă', 'Pere gutui', 'Tămâioase de Călimănești' are potential sources of genes for resistance to fire blight (Cociu et al., 1999).

The pear scab caused by the fungus *Venturia pirina* Aderh with manifestations on leaves, stems and fruits, causes damage to pear production and depreciate these quality. On the attacked fruits, brown spots appear and possibly crap leather, they remain small or can deform, and therefore their market value decreases. Scab generally is not relevant in pear culture as it is in apple. In scab management the main goal is the reduction or prevention of primary infections in spring. If this has been successfully controlled, secondary infections will not be serious.

From the research carried out so far regarding the scab, it appears that none of the varieties of *Pyrus communis* species is immune to the attack caused by the pathogen *Venturia pirina* Aderh. Among the varieties with a good behavior in the scab attack are 'Williams', 'Conference', 'Dr. Jules Guyot' (Bell, 1990), 'Republica', 'Euras', 'Argessis', 'Maria Romana', etc. (Braniste et Andrieș, 1990; Cociu et al., 1999).

Psylla attacks in three ways: it spreads a mycoplasm that causes pears; it injects a toxin on the tissue of the tree as it feed sand produces honeydew while feeding. The attack of this insect can stunt, defoliate, and even kill trees. Because *Psylla* rapidly develops insecticides resistance, chemical control is difficult to do. It has already developed localized resistance to pyretroids all across its range. As such, it is very important to alternate between pesticide classes to prevent or slow resistance (D. Alston, 2007).

The varieties sensitive to the *Psylla* attack are mostly from *Pyrus communis*. *Psylla* resistance has been found in Asian species *P. betulaefolia, P. calleryana, P. fauriei, P. ussuriensis, P. bretschneideri, P. pyrifolia, P. pashia.* In Romania, researches on resistance to *Psylla*, carried out by Braniste (1980) and Andrieș (1990) showed that species *P. lindlezi*, *P.korchinski, P. salicifolia, P. serotina, P. syriaca, P. serulata* are resistant, along with some biotypes and varieties with ascendancy in *P. serotina.* Some Romanian local varieties 'Bulgărești', 'Tomnatice', 'Crăiese', 'Cantalupești', 'Pletoase', 'Popești' and 'Imperiale' have a good behavior at the *Psylla* attack (Militaru et al., 2010; Braniste N., 2000).

The main aims of this study were the evaluation of pear genetic resourceslocated in the germplasm collection at the Research Institute for Fruit Growing Pitesti-Maracineni, and identifying the resistant/tolerant of diseases and pests that would help the reproduction program to obtain resistance/tolerance of varieties to these diseases and pests. The environmental sustainability of pear production would increase with the breeding and development cultivars with durable resistance/tolerance disease and pests.

MATERIALS AND METHODS

The experiment was carried out in pear germplasm collection at the Research Institute for Fruit Growing Pitesti-Maracineni, Romania, from 2020 to 2022. The total number of genotypes studied was 53, 32 of them are local genotypes, 19 are breed Romanian varieties and 3 foreign varieties (Table 5). Within the study, the resistance/tolerance of these genotypes to *Erwinia amylovora*, *Venturia pirina* and *Psylla* sp. was carry out.

Assessment the genotypes to this disease and pest was made in natural condition, with the same currently treatments as in commercial field, uniformly applied to all the cultivars. In collection of Research Institute for Fruit GrowingPitesti- Maracineni each genotype was represented by two trees grafted on franc rootstock, planted on 3.4 m between rows and 2 m between trees on row. In the field, macroscopic observations of the symptoms expression were made according to ECPGR characterization and evaluation descriptors for pear genetic resources, from 1: no visible

symptom to 9: maximum infection, tree completely affected, nearly dead; maximum infection, tree completely affected, nearly all organs with symptoms (Tables 2, 3, 4).
The aim of this study was to investigate and to compare the resistance/tolerance to *Erwinia amylovora*, *Venturia pirina* and *Psylla* sp. for 50 Romanian cultivars (32 local varieties and 18 varieties bred) and 3 foreign varieties.

RESULTS AND DISCUSSIONS

The evaluation of different pears cultivars to fire blight, scab and *Psylla* response showed than the main factor in the development of these diseases and pests was the genotype and the meteorological conditions. Climatic data for the vegetation season (March-October) over the study period 2020-2022, registered at Research Institute for Fruit Growing Pitesti-Maracineni, are shown in Table 1.

Table 1. Meteorological data, registered during 2020-2022

	Year	Months							
		III	IV	V	VI	VII	VIII	IX	X
Temperature (°C)	2020	7,7	10,9	15,0	19,6	22,1	22,2	18,9	12,4
	2021	4,1	8,6	15,6	19,3	23,5	22,4	15,6	7,9
	2022	3,6	10,1	16,4	21,1	22,9	22,6	15,6	12,0
Humidity (%)	2020	62,9	47,7	64,4	71,0	63,2	61,0	62,6	82,4
	2021	64,6	64,8	65,1	73,3	61,4	61,3	67,4	79,9
	2022	65,9	74,7	72,9	75,2	70,3	77,6	84,0	82,6
Rainfall (mm)	2020	30,0	21,1	104,1	166,2	52,0	29,8	68,2	92,7
	2021	66,8	38,4	65,4	104,0	33,5	74,0	14,3	36,3
	2022	19,4	88,0	72,6	25,6	25,3	142,1	49,6	4.3

Evaluation of *Erwinia amylovora* attack. Based on the visual observations related to *Erwinia* attack, in the most resistant class we list: 'Isadora', 'Argessis', 'Euras', 'Romcor', 'Triumf', 'Monica' (score 1 - no visible symptom). The 'Ervina' variety presented the highest average of the attack average of 1.6%, showed severe fire blight symptoms only in 2022, when many branches were damaged (Figure 1). The symptoms were also registered at 'Williams', 'Packham's Triumph', 'Lucele', 'Untoasă de Feleac' cvs. (Table 6).
Evaluation of *Venturia pirina* attack. The results showed that there are enough sources genes for resistance/tolerance to *Venturia pirina*. Cultivars studied showed a very strong scab resistance, only one of them, 'Tomnatice', was identified as sensitive to the pathogen agent with the average of the three years equal to 2.3 (Figure 2).

Figure 1. Fire blight symptomson 'Ervina'cv.

Figure 2. Pear scab symptoms on 'Tomnatice' cv.

Evaluation of *Psylla* attack. The studied varieties showed different responses to this pest attack. During the three years of study the following cultivars have been heavily affected: 'Falcă roșie', 'Văratice' with score average 3.3 for these three years of study, 'Xenia' cv. (2.6), 'Williams' cv. (2.3), 'Galbene tămâioase' cv. (2.6). In some scientific papers, 'Beurre Bosc', 'Conference', 'Williams', 'Abatele Fetel', 'Beurre Hardy', 'Clap's Favorite', 'Passe Crassane' cvs. are considered susceptible (Campbell, 2002) which partial confirm our study.
Romanian varieties 'Isadora' and 'Euras' presented a strong resistance to *Psylla.* The score average for all study period was equal to 1, no symptoms appeared on leaves or fruit.

Table 2. Infection assessment scale to fire blight on branches (Lateur, 1999)

Score	Observation in the orchard	Visual rating estimation Incidence (%)
1	No visible symptom	0
2	One or very few small infections, detectable only on close scrutiny of the tree	[0-1]
3	Directly apparent infections without important consequences for the tree	[1-5]
4	X	X
5	Disease widespread over the branches, inducing the death or the ablation of a large part of the crown	± 25
6	X	X
7	Heavy infection; about half of the crown is badly affected with risk of ablation or death	± 50
8	X	X
9	Maximum infection, tree completely affected, nearly dead	> 90

X = intermediate rating

Table 3. Global assessment scale for scab infection on leaves and fruits (adapted from Lateur and Populer, 1996)

Score	Observation in the orchard	Visual rating estimation	
		Incidence (%)	Severity (%)
1	No visible symptom	0	
2	A few small scab spots are detectable on close scrutiny of the tree	≤ 1	
3	Scab immediately apparent, with lesions very thinly scattered over the tree	> [1-5]	-
4	X	X	-
5	Infection widespread over the tree, majority of leaves/fruits with at least one lesion	≥ 50	≤ 5
6	X	≥ 50	X
7	Heavy infection; multiple lesion or more large surfaces covered by scab on most leaves/fruits. Partial leaf fall; some fruits with skin cracks in scabbed lesions	≥ 50	± 25
8	X	≥ 50	X
9	Maximum infection, leaves black with scab often fallen; fruits black with scab	≥ 50	>75

X = intermediate rating

Table 4. *Psylla* sp. on leaves and fruits (adapted from Lateur, 1999)

Score	Observation in the orchard	Visual rating estimation Incidence (%)
1	No visible symptom	0
2	One or very few foci, detectable only on close scrutiny of the tree	[0-1]
3	Directly apparent foci without consequences for the tree	[1-5]
4	X	X
5	Number of foci widespread over the branches, inducing the curling of leaves	± 25
6	X	X
7	Heavy infection; about half of the leaves/fruits is badly	± 50
8	X	X
9	Maximum infection, tree completely affected, nearly all organs with symptoms	> 90

X = intermediate rating

Table 5. Origin of pear cultivars included in evaluation at RIGF Pitești-Mărăcineni

No	Variety	Origin
1	Aniversare	Doynned'hiver x Curé
2	Anțig	Local variety
3	Argessis	Napoca x Butirra precoce Morettini
4	Boierești	Local variety
5	Busuioace	Local variety
6	Carpica	Napoca x Butirra precoce Morettini
7	Codiță	Local variety
8	Corina	Passe Crassane x (B.c.*Pyrus serotina* x Olivier de Seres)x Decana de iarna
9	Cristal	(Rosior pietros x Decana de iarna) x Decana de iarna x Beurre Hardy
10	Cu miezul roșu	Local variety
11	Daciana	Napoca x Butirra precoce Morettini
12	DecanaKrier	Local variety
13	Ervina	(*Pyrusserotina* x Williams) x Napoca
14	Euras	(B.c.*Pyrus serotina* x Olivier de Seres) x Decana de iarna
15	Falcă roșie	Local variety
16	Fetița	Local variety
17	Galbene tămâioase	Local variety
18	Harbuzești	Local variety
19	Haydeea	Beurré Hardy x Beurré six
20	Imperiale	Local variety
21	Isadora	Haydeea x Tse Li (*Pyrusserotina*)
22	Lucele	Local variety
23	Lucii timpurii	Local variety
24	Monica	Santa Maria x Principe di Gonzaga
25	Mustoase	Local variety
26	Napoca	Dr. Jules Guyot x pollen mix (Clapp's favorite, Beurré, Clairgeau, Williams, Pastravioare, Zaharoase de vara)
27	Nina de Vișani	Local variety
28	Packham's Triumph (control)	Uvedalé's St. Germain x Williams' Bon Chrétien
29	Para de vin	Local variety
30	Para lui Niță	Local variety
31	Paradise	H 26-67-73 x Pastravioare
32	Paradox	Monica x Pastravioare
33	Paramis	Monica x Passe Crassane
34	Pepenii	Local variety
35	Pere de iarnă	Local variety
36	Pere gutui	Local variety
37	Piperate de toamnă	Local variety
38	Postatele	Local variety
39	Republica	Doyenne d'hiver x Madame Levavasseur
40	Romcor	Passe Crassane x (*Pyrus serotina* x Olivier de Serres) x Decana Comisiei
41	Roșii de iulie	Local variety
42	Sărsării	Local variety
43	Sântălieşti	Local variety
44	Tămâioasă mică	Local variety
45	Tomnatice	Local variety
46	Triumf	Napoca x Beurré Giffard
47	Tudor	*(Pyrus serotina* x Decana de iarna) x Passe Crassane) x 30-40 Angers
48	Untoasă de Ardeal	Local variety
49	Untoasă de Feleac	Local variety
50	Untoasă de Târgu Mureș	Local variety
51	Văratice	Local variety
52	Williams	UK
53	Xenia	Triomphe de Vienne x Nicolae Krier

Table 6. Mean score of fire blight attack

No.	Variety	2020	2021	2022	Average
1	Aniversare	1	1	1	1.0
2	Anţig	1	1	1	1.0
3	Argessis	1	1	1	1.0
4	Boiereşti	1	1	1	1.0
5	Busuioace	1	1	1	1.0
6	Carpica	3	1	1	1.6
7	Codiţă	1	1	1	1.0
8	Corina	1	1	1	1.0
9	Cristal	1	1	1	1.0
10	Cu miezul roşu	1	1	1	1.0
11	Daciana	2	1	1	1.3
12	Decana Krier	1	1	1	1.0
13	Ervina	1	1	3	1.6
14	Euras	1	1	1	1.0
15	Falcă roşie	1	1	1	1.0
16	Fetiţa	1	1	1	1.0
17	Galbene tămâioase	1	1	1	1.0
18	Harbuzeşti	1	1	1	1.0
19	Haydeea	1	1	1	1.0
20	Imperiale	1	1	1	1.0
21	Isadora	1	1	1	1.0
22	Lucele	2	1	1	1.3
23	Lucii timpurii	1	1	1	1.0
24	Monica	1	1	1	1.0
25	Mustoase	1	1	1	1.0
26	Napoca	1	1	1	1.0
27	Nina de Vişani	1	1	1	1.0
28	Packham's Triumph	2	2	1	1.6
29	Para de vin	1	1	1	1.0
30	Para lui Niţă	1	1	1	1.0
31	Paradise	1	1	1	1.0
32	Paradox	1	1	1	1.0
33	Paramis	1	1	1	1.0
34	Pepenii	1	1	1	1.0
35	Pere de iarnă	1	1	1	1.0
36	Pere gutui	1	1	1	1.0
37	Piperate de toamnă	1	1	1	1.0
38	Postatele	1	1	1	1.0
39	Republica	1	1	1	1.0
40	Romcor	1	1	1	1.0
41	Roşii de iulie	1	1	1	1.0
42	Sărsării	1	1	1	1.0
43	Sântâlieşti	1	1	1	1.0
44	Tămâioasă mică	1	1	1	1.0
45	Tomnatice	1	1	1	1.0
46	Triumf	1	1	1	1.0
47	Tudor	1	1	1	1.0
48	Untoasă de Ardeal	2	1	1	1.3
49	Untoasă de Feleac	1	2	1	1.3
50	Untoasă de Târgu Mureş	1	1	1	1.0
51	Văratice	1	1	1	1.0
52	Williams	2	1	1	1.3
53	Xenia	1	1	1	1.0

Table 7. Mean score of pear scab attack

No.	Variety	2020	2021	2022	Average
1	Aniversare	1	1	1	1.0
2	Anţig	1	1	1	1.0
3	Argessis	1	1	1	1.0
4	Boiereşti	1	1	1	1.0
5	Busuioace	1	1	1	1.0
6	Carpica	1	1	1	1.0
7	Codiţă	1	1	1	1.0
8	Corina	1	1	1	1.0
9	Cristal	1	1	1	1.0
10	Cu miezul roşu	1	1	1	1.0
11	Daciana	1	1	1	1.0
12	Decana Krier	1	1	1	1.0
13	Ervina	1	1	1	1.0
14	Euras	1	1	1	1.0
15	Falcă roşie	1	1	1	1.0
16	Fetiţa	1	1	1	1.0
17	Galbene tămâioase	1	1	1	1.0
18	Harbuzeşti	1	1	1	1.0
19	Haydeea	1	1	1	1.0
20	Imperiale	1	1	1	1.0
21	Isadora	1	1	1	1.0
22	Lucele	1	1	1	1.0
23	Lucii timpurii	1	1	1	1.0
24	Monica	1	1	1	1.0
25	Mustoase	1	1	1	1.0
26	Napoca	1	1	1	1.0
27	Nina de Vişani	1	1	1	1.0
28	Packham's Triumph	1	1	1	1.0
29	Para de vin	1	1	1	1.0
30	Para lui Niţă	1	1	1	1.0
31	Paradise	1	1	1	1.0
32	Paradox	1	1	1	1.0
33	Paramis	1	1	1	1.0
34	Pepenii	1	1	1	1.0
35	Pere de iarnă	1	1	1	1.0
36	Pere gutui	1	1	1	1.0
37	Piperate de toamnă	1	1	1	1.0
38	Postatele	1	1	1	1.0
39	Republica	1	1	1	1.0
40	Romcor	1	1	1	1.0
41	Roşii de iulie	1	1	1	1.0
42	Sărsării	1	1	1	1.0
43	Sântâlieşti	1	1	1	1.0
44	Tămâioasămică	1	1	1	1.0
45	Tomnatice	1	5	1	2.3
46	Triumf	1	1	1	1.0
47	Tudor	1	1	1	1.0
48	Untoasă de Ardeal	1	1	1	1.0
49	Untoasă de Feleac	1	1	1	1.0
50	Untoasă de Târgu Mureş	1	1	1	1.0
51	Văratice	1	1	1	1.0
52	Williams	1	1	1	1.0
53	Xenia	1	1	1	1.0

Table 8. Mean score to *Psylla* attack

No.	Variety	2020	2021	2022	Average
1	Aniversare	3	1	2	2.0
2	Anţig	2	1	2	1.6
3	Argessis	3	3	2	2.6
4	Boiereşti	3	3	2	2.6
5	Busuioace	2	2	2	2.0
6	Carpica	3	2	2	2.3
7	Codiţă	3	3	3	3.0
8	Corina	1	2	1	1.3
9	Cristal	2	1	2	1.6
10	Cu miezul roşu	2	2	1	1.6
11	Daciana	3	2	2	2.3
12	Decana Krier	1	1	1	1.0
13	Ervina	1	1	1	1.0
14	Euras	1	1	1	1.0
15	Falcă roşie	5	3	2	3.3
16	Fetiţa	3	1	1	1.3
17	Galbene tămâioase	3	3	2	2.6
18	Harbuzeşti	3	3	2	2.6
19	Haydeea	2	2	2	2.0
20	Imperiale	3	3	2	2.6
21	Isadora	1	1	1	1.0
22	Lucele	2	2	2	2.0
23	Lucii timpurii	3	3	1	2.3
24	Monica	1	1	2	1.3
25	Mustoase	3	3	3	3.0
26	Napoca	3	3	2	2.6
27	Nina de Vişani	3	3	2	2.6
28	Packham's Triumph	3	3	1	2.3
29	Para de vin	2	2	1	1.6
30	Para lui Niţă	3	1	3	2.3
31	Paradise	3	1	1	1.6
32	Paradox	1	1	1	1.0
33	Paramis	2	2	2	2.0
34	Pepenii	1	1	1	1.0
35	Pere de iarnă	1	1	3	1.6
36	Pere gutui	2	2	2	2.0
37	Piperate de toamnă	3	2	2	2.3
38	Postatele	2	2	2	2.0
39	Republica	2	1	2	1.6
40	Romcor	2	1	1	1.3
41	Roşii de iulie	3	3	3	3.0
42	Sărsării	2	2	2	2.0
43	Sântălieşti	3	2	1	2.0
44	Tămâioasă mică	3	2	1	2.0
45	Tomnatice	2	2	2	2.0
46	Triumf	2	3	2	2.3
47	Tudor	2	1	1	1.3
48	Untoasă de Ardeal	2	2	2	2.0
49	Untoasă de Feleac	3	2	2	2.3
50	Untoasă de Târgu Mureş	3	2	2	2.3
51	Văratice	5	3	2	3.3
52	Williams	3	2	2	2.3
53	Xenia	3	3	2	2.6

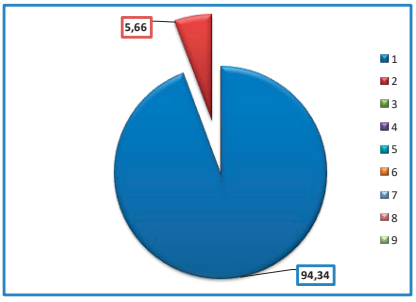

Figure 3. Proportion of genotypes with fire blight symptoms

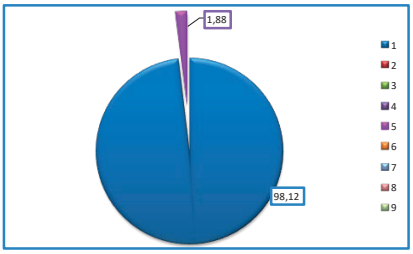

Figure 4. Proportion of genotypes with pear scab symptoms

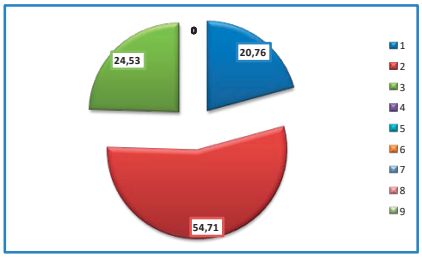

Figure 5. Proportion of genotypes with pear *Psylla* attack symptoms

CONCLUSIONS

The different response of pear varieties to diseases and pests attack, tested at RIFG Pitesti, Romania denoted a large variability, a strong influence of the genotype in the expression of resistance or tolerance to the *Erwina amylovora*, *Venturia pirina* and *Psylla* sp. Also, the meteorological conditions influenced the appearance of these pathogens and pests.

The Romanian cultivar 'Isadora' was noted for high resistance to diseases and pest compared to other cultivars tested in the same conditions.

For fire blight, 50 pear cultivars (94.34% of studied genotypes), were registered with “no visible symptom”.

From 53 studied genotypes, 'Tomnatice' was the scab susceptible cultivar, only, which is not recommended to be grown in climatic conditions from Mărăcineni, Argeş.

The response of the 53 genotypes studied to *Psylla* attack was very different: 20.76% of them with “no visible symptom”, 54.71% with “one or very few foci, detectable only on close scrutiny of the tree” and 24.53% was “directly apparent foci without consequences for the tree”.

Several cultivars registered with “no visible symptom” and considered as

resistance/tolerance to diseases and pests could be used for further pear breeding programs.

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