

## ASSESSMENT FOR RESISTANCE GENES AGAINST PATHOGEN *VENTURIA PYRINA* ADERH. IN LOCAL, SELECTED AND INTRODUCED VARIETIES OF PEAR CULTIVATED IN AZERBAIJAN

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**Abstract.** Pear scab (*Venturia pyrina* Aderh.) is the most perilous fungal disease of the pear plant and from an economic point of view, it causes considerable crop loss in the orchards of our country. Fungicides are mainly used to treat trees to struggle disease. The use of resistant cultivars in production of disease control is most important alternative ways. For this purpose, in our experiment, we found out whether local, selected and introduced pear varieties of Azerbaijan are durable to the pathogen *Venturia pyrina* Aderh. The seedlings taken for this purpose are thoroughly infected by spraying on 3-5 leaves. The durable of selected pear cultivars to the pathogen *Venturia pyrina* was basically defined by Chevalier et al. was estimated with a 4-point system and the research results were analysed accordingly. 12% of the plants were scored 1 for the absence of disease symptoms, 29% were scored 2 and 3a for poorly formed spores, but 59% were scored 3b and 4 due to the presence of junior lesions. Among local pear cultivars, Gorkhmazi, Nar, Gov, Ispiya, Cir, Khirda serchebudu, Sini, Uzunbogaz, Boyuk uzunbogaz, selected pear varieties Form3, Form7, introduced pear varieties William, Clapp's favorite and Cure were found to be more infected. Highly durable pear various identified during the study can be used for pear scab introgression in breeding programs.

**Keywords:** Pear genotypes, scab infection, resistance, evaluation, *Venturia pyrina*.

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### 1. Introduction

Pear scab (*Venturia pyrina*) is an economically significant disease common in almost all pear (*Pyrus communis* L.) growing areas. The disease occurs as a result of infection of the fruit, which has a greater impact on the yield and quality of the pear plant. Weather conditions (especially humidity) and the sensitivity of varieties are one of the main factors for the occurrence of scab disease (Sokolova *et al.*, 2014; Ebrahimi, 2020; Deng *et al.*, 2017).

*Venturia pyrina* ascospores develop at temperatures of 60°-260°C and high humidity, forming a primary infection. Ascospores fly for 5-9 weeks and the first symptoms of the disease appear on leaves, fruits and shoots 8-15 days after spreading. The size of the spots, depending on the age of the leaves, the weather conditions and susceptibility of cultivars, was first determined as weak, then dark gray and olive velvet.

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Younger leaves of susceptible varieties develop larger spots under high humidity conditions. Heavily infected leaves turn yellow, dry and poured (Ishii & Kimura, 2018).

Pear Scab is an economically important disease on pear. Most fungicide applications in pear production are aimed at preventing this disease. The pear scab fungus forms ascospores just like apple scab, but can also overwinter on 1- to 3-year-old wood. These wood scab cankers produce conidiospores starting before bud break and lasting till summer. Pear Scab lesions on leaves are mainly found on the underside of the leaves, in low numbers, even where a high number of fruits is showing symptoms. Typically, the first lesions on fruits are found immediately after bloom, resulting from pre-bloom infections. Most of these fruits drop in the weeks after. Later symptoms become only visible during the last month or weeks before harvest and tend to increase during storage. The severity of damage increases during the cool and humid spring months. If the epidemic gets out of control 50-100% of the fruits may become unmarketable (Sobreiro & Mexia, 1998; Jamar *et al.*, 2017; Kim *et al.*, 2016).

Furthermore, the genetic diversity of these genotypes was studied by us and some selected pear varieties were determined to be more suitable for use (Babayeva, 2021a).

Generally, breeding programs should focus on the production of varieties resistant to pear scab. Screening against scab in pear genotypes available in different regions of the Republic has not yet been done by any researcher, so it is absolutely important to do this work. Therefore, the aim of our research was to determine the resistance to scab of various pear genotypes cultivated in Azerbaijan and to identify resistance varieties for the future breeding process. To achieve this goal, in this study, we determined the degree of resistance against the pathogen *Venturia pyrina* by inoculating diverse pear genotypes with artificial inoculation.

## 2. Material and methods

### Sampling

In this experiment, 5 samples of each of 41 local, introduced and selected pear genotypes were taken from the orchards of Guba, Shamakhi, Gabala, Ganja, Tovuz and Masalli regions of Azerbaijan (Babayeva, 2021b). Afterwards grafted on OHF-87 rootstock in the greenhouse for the purpose of scientific research. On April 26, 2023, it was prepared a spore suspension at the Virology Laboratory of the Institute of Genetic Resources of the Ministry of Science and Education of the Republic of Azerbaijan, using the conidia of the samples taken from the isolates of *Venturia pyrina* infected with scab disease under the guidance of Dr. Evrim, who works at the Suleyman Demiral Institute located in Isparta, Turkey. All seedlings are thoroughly infected by spraying 4-5 leaves. During our experiment, 41 plants in OHF-87 rootstock were provided with water, light, fertilizer and pesticides under greenhouse conditions (Automatic, Watering, Heating: 6°C, 18°C, 21°C) Ventilation: 8°C, 21°C, 23°C). Pear seedlings were infected with scab using the pretreated suspension on 8 May 2023 and evaluated twice on 18 June and 25 June of the same year. The assessment was done according to table 1 given by Chevalier *et al.* (1991).

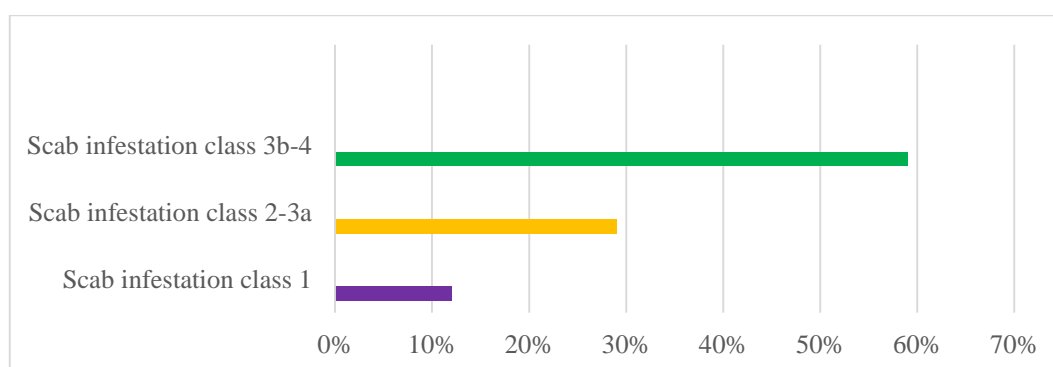
Seedlings were contaminated by spraying 4-5 leaves. The density of conidia was defined by counting suspended droplets under a microscope and their concentration was 105 germinating conidia per ml. The obtained conidia suspension was kept at -20°C. After spraying, seedlings were incubated at 20°C at ~90-100% humidity for 2 days, afterwards 2 days, seedlings were kept in a greenhouse booth with ~80-90% humidity.

**Table 1.** Assessment of pear scab infection classes

Class 0	Class 1	Class 2	Class 3a	Class 3b	Class 4
	Excessive sensitivity	Star-shaped necrosis	Star-shaped necrosis / chlorosis	Chlorosis	Sensitivity
There are no signs of scab	"Pin-point pits" appear 4-6 days after grafting and then do not grow any further. They correspond to extreme sensitivity	7-10 days after grafting, chlorotic lesions without sporulation. Leaves may appear wrinkled	Necrotic and chlorotic lesions with soft, scanty sporulation	Necrotic and chlorotic lesions, signed sporulation	Sturdy, scanty sporulation, no durability reaction

### 3. Research results and discussion

In our experiment, we evaluated the durability of forty one pear varieties to pear scab. Seedlings were infected on May 8, 2023 and their assessment was carried out twice, on June 18 and June 25.

**Figure 2.** Assessment of pear scab infestation classes in seedlings with percentage

*Rvi2* and *Rvi4* persistence resistance genes can cause different resistance responses in various pear genotypes. *Rvi2* and *Rvi4* resistance genes can be classified into classes 3b, 3a, 2 and mostly 0, depending on the genetic mix of the pathogen *Venturia pyrina* in pear plant and its combination with other scab resistance. It seems that none of the pear varieties we used were assigned to “class 0” that is, the symptom of the scab disease was observed in all varieties. The symptoms of the scab disease appeared as small dots (*Vm* or *Vh4*) in Jir Nadiri pear, Khanim pear, Tikani pear, Qend pear, Shushe pear and formed in class 1 with 12%. Star-shaped necrotic spots were observed in Gara and Dash pear varieties and grouped in the “class 2” with 5%. Xirda nargila, Abasbayi, Ahmadgazi, Meshe pear, Form4, Form5, Duchesse de Angouleme, Beurre Bosc, Passe Crassane and Bere Ardanpon pear varieties were included in the “class 3a” and poorly durable.

The vast majority of pear varieties were highly susceptible to scab disease and they belonged to the “class 4” of scab infection. Gov, Nar, Gorkhmazi, Ispiye, Cir pear, Xirda serchebudu, Sini pear, Uzunbogaz, Boyuk uzunbogaz, Form3, Form7, Williams, Clapp's

favorite and Cure were classified in “class 4”. After the resistance breakthrough, classification in “class 4” is also possible if there is race 7 of *Venturia pyrina* at the inoculation that can be excluded here. The second largest group is infestation “class 3b” with 24% (Serchebudu, Yemish pear, Garpiz pear, Zanciraband, Qush pear, Bal pear, Form1, Form2, Form6 and Gozalcha pear varieties).

**Table 2.** The name of pear genotypes used in the experiment, their origin, paternity and grade of resistance to scab disease

No	The name of genotypes	Origin	Parentage	Grade of resistance
1	Serchebudu	Guba, Azerbaijan	Unknown	HS
2	Yemish pear	Guba, Azerbaijan	Unknown	HS
3	Garpiz pear	Guba, Azerbaijan	Unknown	HS
4	Gorkhmazi	Guba, Azerbaijan	Unknown	HS
5	Khanim pear	Guba, Azerbaijan	Unknown	Re
6	Xirda nargila	Guba, Azerbaijan	Unknown	LS
7	Nar pear	Guba, Azerbaijan	Unknown	HS
8	Jir Nadiri	Guba, Azerbaijan	Unknown	Re
9	Gara pear	Guba, Azerbaijan	Unknown	LS
10	Tikani pear	Guba, Azerbaijan	Unknown	Re
11	Gov pear	Guba, Azerbaijan	Unknown	HS
12	Abasbayi	Guba, Azerbaijan	Unknown	LS
13	Ahmadgazi	Guba, Azerbaijan	Unknown	LS
14	Zanciraband	Guba, Azerbaijan	Unknown	HS
15	İspiye	Guba, Azerbaijan	Unknown	HS
16	Cir pear	Guba, Azerbaijan	Unknown	HS
17	Qush pear	Tovuz, Azerbaijan	Unknown	HS
18	Meshe pear	Tovuz, Azerbaijan	Unknown	LS
19	Dash pear	Tovuz, Azerbaijan	Unknown	LS
20	Xirda serchebudu	Tovuz, Azerbaijan	Unknown	HS
21	Qend pear	Ganja, Azerbaijan	Unknown	Re
22	Shushe pear	Ganja, Azerbaijan	Unknown	Re
23	Sini pear	Gabala, Azerbaijan	Unknown	HS
24	Bal pear	Gabala, Azerbaijan	Unknown	HS
25	Uzunbogaz pear	Masalli, Azerbaijan	Unknown	HS
26	Boyuk uzunbogaz	Masalli, Azerbaijan	Unknown	HS
27	Form1	Gabala, Azerbaijan	Bal pear × Williams	HS
28	Form2	Shamaxi, Azerbaijan	Abasbayi × Cir pear	HS
29	Form3	Shamaxi, Azerbaijan	Abasbayi × Beurre Bosc	HS
30	Form4	Shamaxi, Azerbaijan	Qush pear × Clapp's favorite	LS
31	Form5	Shamaxi, Azerbaijan	Cure × Ahmadgazi	LS
32	Form6	Shamaxi, Azerbaijan	Ahmadgazi × Williams	HS
33	Form7	Masalli, Azerbaijan	Dash pear × Cure	HS
34	Gozalcha	Uzbekistan	Unknown	HS
35	Williams	England	Unknown	HS
36	Clapp's favorite	Massachusetts	Unknown	HS
37	Duchesse de Angouleme	France	Unknown	LS
38	Beurre Bosc	France or Belgium	Unknown	LS
39	Cure	France	Unknown	HS
40	Passe Crassane	France	Unknown	LS
41	Bere Ardanpon	Belgium	Unknown	LS

\* Re – durable, LS - low sensitivity, HS - highly sensitive

It is necessary to achieve pyramiding of resistance from parent plants in selected varieties. It can be accepted by ~4/5 of the population, confirming that pyramiding has been achieved, which can be attributed to the scale infestation class 0. A small proportion of plants in our study belonged to classes 1 and 2. However, the tasks assigned to classes 3a, 3b and 4 are complicated to clarify. We can only complete that the connection between durable and the durable gene, as well as outer environment and affects, is not yet totally got it.

#### 4. Conclusion

Our country occupies a considerable area due to pear genetic resources. The obtained results show that most pear genotypes cultivated in Azerbaijan are susceptible to the pathogen *Venturia pyrina* Aderh. From here it can be concluded that the breeding of high-brand pear cultivars favorable for manufacturing places and durable to scab disease will bring super added cost to economy of the country. Modern origins of durable may be used in stable breeding programs in the near future.

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