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COMPORTAREA UNOR GENOTIPURI DE PRUN LA ATACUL UNOR PATOGENI MICOTICI

BEHAVIOR OF SOME PLUM GENOTYPES ON PATHOGENIC FUNGI ATTACK

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Abstract

Common plum (*Prunus domestica* L.) represents the main fruit species in South-East Europe, both as cultivated surface and fruit production as well. In Romania, the common plum is grown on more than 65.000 ha, its fruits being appreciated for fresh consumption or processed, as a source of fitonutrients and active principles. Therefore, now days there are a real interest for genetic resources evaluation, assortment improvement, and growing technologies or sequences modernization. The work presents the results on the behavior of some common plum genotypes on natural infections with patogenic fungi. 94 de plum genotypes (34 from Romania and 60 from abroad) with ages ranging between 4 and 7 years, grafted on 7 rootstocks, were evaluated as regard their behavior to natural infections with pathogenic fungi such as moniliosis - *Monilia laxa*, red spot - *Polystigma rubrum* și micotic shoothole - *Stigmina carpophila*. At the end of the study was found that among the trees aged of 4-5 years, the most sensitive genotypes were: 'Jubileum' (VSI%=0.390), 'SW H 0834' (VSI%=0.490) and 'Hanita' (VSI%=0.670). Among the trees aged of 6-7 years, the most sensitive genotypes were: 'Centenar' (ISV%=0.445-0.883), 'Andreea' and 'Romanța' (VSI%=0.388-0.638), 'Čačanska Lepotiča' (VSI%=0.374-0.416), 'Timočanka' (VSI%=0.425) and 'Jojo' (VSI%=0.459-0.487). Therefore, the mentioned genotypes needs with priority integrated phytoprotection.

Cuvinte cheie: prun, patogeni micotici, sensibilitate soiuri, fitoprotecție integrată.
Key words: plum, micotic pathogens, varietal sensitivity, integrated phytoprotection.

1. Introduction

In temperate areas of the Globe, European plum is the main tree fruit species due to the role of fruits in human nutrition and due to certain agro-biological features such as: it is well adapted to the temperate climate, with the extreme values of the meteorological parameters and the low fertile soils. Plum culture is one of the most important of the national and European horticulture as well, Romania holding the first place as regard the plums production (757,830 tons fruits/year) and planted surfaces (67,010 ha) (FAOSTAT, 2023). In our country plum production is an important branch of the horticulture sector, a traditional activity of the peoples living in countryside area and an important source of incomes as well, its fruits being appreciated for fresh consumption or processed as a source of fitonutrients and active principles and by consequence valuable source of raw material for the food industry. With an average fruit production in 2023 of 757,830 t and 67,010 ha, our country held the first place among the plums producing countries, before Italy, Spain, Poland and France (Fig. 1 and 2). The plums are pore in proteins (0.8 g %) and lipids (0.2%) with low caloric values (75 calories/ 100g fresh fruits). They are rich in potassium (170 mg%), calcium (12 mg%), magnesium (10mg%), phosphorus (18mg%), sodium (1mg%), iron (0,5mg%), etc. The vitamins present in plums are, C (<4 mg%), carotens (0.9 mg%), B1 (0.83 mg%), B2 (0.03 mg%), PP (1 mg%), etc. The plum fruits anthocians contents has bacteriostatic activity, and diuretic activity (Dragoi and Braniste 1999). Grown in many systems, the technological level is different according to area, but after EU admission, in the last 10-15 years, the situation changed very fast. The most spread plums cultivars are 'Stanley', 'Anna Späth', 'd'Agen', 'Early Rivers', 'Tuleu gras', 'Reine Claude Althan', 'Vinete românești', 'Agent', 'Centenar', 'Andreea', 'Romanța', 'Record', 'Čačanska Lepotiča', 'Čačanska Rodna', 'Valor', 'Vision', 'Bluefree' and many others cultivars which were released by the fruit assortment breeding programs. Soils diversity, climate changes and different level of the applied technology, new introduced varieties are favourable for the strike of various pest and diseases. For these reasons, to obtain high quality fruits, use of performing registered cultivars, of innovative cultivation techniques and phytoprotection programs are key components of production chain in the modern super intensive orchards (Cociu and Oprea, 1989; Teodorescu, 2000; Amzăr and Ivașcu, 2003; Tomșa and Tomșa, 2003; Braniște et al., 2006; Braniște et al., 2007). Therefore all the plum varieties and especially the new ones, must be tested under concrete orchard conditions as regard their behaviour to various specific damaging organisms and among them the wide spread pathogenic fungi.

Monilia laxa is a fungus from *Ascomycetes* responsible for the plum blossom brown rot disease, the most damaging one (Tamm et al., 1995; Gouramanis, 1999; Viret and Siegfried, 2011; Perren et al.,

2020) which infects many different types of stone fruit trees such as apricots, cherries and peaches. This fungus can cause significant damage in fruit production and gradually lead to the drying of trees. Symptoms include attack on branches, leaves, flowers and fruit. If you have problems with moniliosis, it is recommended to destroy the shoots and fruits affected by burning, as well as treatments with specific fungicides during the growing season (Canon et al., 2017; Gubler et al., 2017).

Polystigma rubrum, also known as plum red leaf spot, is a disease that affects plum trees. This manifests itself especially in years with rainy springs and can cause defoliation of the leaves. Symptoms include roughly circular spots on leaves, initially cream-yellow, then orange, and finally brick-red. The pathogen, *Polystigma rubrum*, overwinters in plant debris left on the soil and produces secondary infections during the growing season (Pârvu, 2003; Douglas, 2018; Roberts et al. 2018).

Stigmina carpophila (syn. *Wilsonomyces carpophilus*) is a fungal pathogen that causes the disease known as pitting in fruit trees of the genus *Prunus*, such as cherries, apricots, peaches and other stone trees. This disease affects the leaves, causing the appearance of small light-brown spots, which later lead to the detachment of the tissues and their perforation. Attack is favored by wounds in the bark, such as those produced by hail or insects (Evans et al., 2008, Ivanova et al., 2012; Veteket et al., 2017).

2. Material and methods

The researches were conducted during 2021-2022, at Research Institute for Fruit Growing Pitesti, Romania (44.51.30 N, 24.52.00 E; 240 m altitude), where the plantings are located on loam-clay soils, poor in nitrogen and phosphorus (nitrogen index 0.33-1.43; PAL 1.3-2.5 mg /100 g) but well supplied with potassium (up to 40 mg /100g). The soil physical properties, (the cationic exchange capacity 68.4 me /100 g, water holding capacity 50%, organic matter content less than 1.8, and the soil pH 5.6) being favourable for growing plums. However, the multi-annual climatic data (1969-2021) reveals annual rainfall plus of 121 mm, from October to February and annual rainfall deficits of 153 mm, from March to September.

The biological material for the trials consisted in more than 95 Romanian and foreign plum genotypes, grafted on 7 rootstocks, and planted in experimental orchards with density ranging between 833 and 1,000 trees/ha, trained as open vase.

The maintenance treatments with insecticides were precise forecasted based on the reserve of the key pests which survived over winter, the plum trees phenological stages, and also in relation with the evolution of the climatic parameters, monitored and registered with the WatchDog and Pessl automate weather stations and their software. Meteorological data were stored, processed and analyzed using the facilities of the Specware 9.0 (Spectrum Technologies Inc. 60544 Plainfield Illinois, USA) and iMetos 3.0 (Pessl GmbH Austria) professional software and their pest and diseases forecast modules.

In the experimental plots the treatments with insecticides were applied with STIHL 400 series and in the demonstrative plots the treatments were carried out using the OSELLA 400 or 1000 spraying machinery powered by Goldoni Star or U 445 DTC tractors.

The quality of the coverage was verified using Novartis hidrosensitive paper and assessed using SnapCard mobile application developed by the University of Western Australia and the Department of Agriculture and Food; the rests of products, solution, and water from washing the spraying equipment were neutralized in installations type Pytobac, Heliosec or RemDry.

The damages caused in by pathogenic fungi were estimated, both as attack incidence or frequency (F %) and as attack severity or intensity (I). The attack frequency was calculated using the formula: **F = n / Nx100**, where, n = number of affected organs, and N = total number of the de observed organs. To evaluate the attack intensity (I) the notes upon a 1-7 scale was used, where, 1=lack of the attack; 2= <3% attack; 3=3-10% attack; 4=11-25% attack; 5=26-50% attack; 6=51-75% attack and 7=76-100% attack.

Then average damages degree were determined by the main pathogenic fungi on plum trees and crop DD% was calculated using the formula **DD% = F% x I/100**.

For each genotype and age, was calculated the varietal sensitivity index (VSI %), using the formula **VSI% = DD%$_1$+ DD%$_2$+ DD%$_3$+ … DD%$_n$**.

3. Results and discussions

3.1 Climatic conditions

The meteorological data collected and processes from 1969 to 2021 at RIFG Pitesti Maracineni reveal a continental excessive type microclimate with an average temperature of 11.6 ºC, a minimum temperature of -24.4 ºC, and a maximum of 38.8 ºC. The mean annual pluviometric excedent is 121 mm and the mean annual pluviometric deficit is 153 mm.

Previously, in 2020, a correlation ($y=59.758e^{0,0065}$ $R^2 = 0.0146^{**}$; $r=0.120^{**}$.) between average air temperature and air relative humidity was found which is favourable for brown rot attack on stone fruits, and other fungi diseases as well.

3.2 *B*rown rot - *Monilia laxa* attack

Assessment of the figures 4-5 show a very good behavior of the studied genotypes aged of 4 -5 years on brown rot attack regardless the genotypes origins or rootstock on which were grafted. However, the damages degree reach DD%=0.48 on fruits of 'SW H 0834' and DD%=0.40 on shoots of 'Hanita'. 'Vision'.

Among the Romanian varieties aged of 6-7 years, the most affected fruits were encountered at 'Piteștean/B83-8' (DD%=0.137), 'Andreea' on 'Redutabil'', 'Mirobolan dwarf' or 'Mirodad 1' rootstocks (DD%=0.133-0.233) and 'Centenar' on 'Mirodad 3', 'Mirodad 1' or 'Aidared' rootstocks (DD%=0.188-0.235). The most affected shoots were found at 'Piteștean/BN4Kr' (DD%=0.043), 'Andreea/Mirodad 1' (DD%=0.167), 'Andreea/Redutabil' (DD%=0.230).

Among the foreign varieties aged of 6-7 years, the most affected fruits were found at 'Stanley/Redutabil' (DD%=0.043) and 'Timočanka' (DD%=0.193). The most affected shoots were found at 'Jojo/Mirodad 2' (DD%=0.147), 'Jojo/BN4Kr' (DD%=0.122) and 'Čačanska Lepotiča/Mirodad 2' (DD%=0.117).

3.3 Red spot - *Polystigma rubrum* attack

Analysis of the figures 6-7 show a very good behavior of the studied genotypes aged of 4-5 years on brown rot attack regardless the genotypes origin or rootstock on which was grafted.

However, the damages degree reach DD%=0.09 on leaves of 'Topend' and DD%=0.06 on shoots of 'Joganta'. Among the Romanian varieties aged of 6-7 years, the most affected on leaves were found at 'Andreea/Mirodad 1' (DD%=0,167), 'Romanța/BN4Kr' (DD%=0.090), 'Andreea/Adaptabil' (DD%=0.083) and 'Romanța/Mirobolan dwarf' (DD%=0.071).

In the case of 'Centenar' cv. the red spot damages degree ranged between DD%=0.117-0.151. Among the foreign varieties aged of 6-7 years, the most affected leaves were found at 'Čačanska Lepotiča/Adaptabil' (DD%=0.131), 'Čačanska Lepotiča/BN4Kr' (DD%=0.098), 'Jojo/BN4Kr' (DD%=0.070) and 'Jojo/Mirobolan dwarf' (DD%=0.061).

3.4 Shoot hole - *Stigmina carpophila* attack

Analysis of the figures 8-9 reveal a very good behavior of the studied genotypes aged of 4-5 years on brown rot attack regardless the genotypes origin or rootstock on which was grafted.

However, the damages degree reach DD%=0.07 on leaves of 'Hanita' and DD%=0.13 on leaves of 'Habella' varieties.

3.5 Varietal sensitivity index (VSI%)

In order to aggregate the evaluations results and to have an overview on the studied genotypes behaviour to main fungal diseases, the varietal sensitivity index was calculated

Analysis of the figures 10-12 reveal a very good behavior of the studied genotypes aged of 4-5 years on brown rot, red spot and shoot hole cumulative attack and a most differentiate one at the age of 6-7 years old. It was found that among the trees aged of 4-5years, the most sensitive genotypes were: 'Jubileum' (VSI%=0.390), 'SW H 0834' (VSI%=0.490) and 'Hanita' (VSI%=0,670). Among the trees aged of 6-7 years, the most sensitive genotypes were: 'Centenar' (ISV%=0.445-0.883), 'Andreea' and 'Romanța' (VSI%=0.388-0.638), 'Čačanska Lepotiča' (VSI%=0.374-0.416), 'Timočanka' (VSI%=0.425) and 'Jojo' (VSI%=0.459-0.487).

Also, a correlation between genotypes and VSI% was found and it is described by the equation and regression indices ($y = 0.0194x + 4.5668$, $R^2 = 0.6670^{**}$; $r = 0.8167^{**}$).

Therefore, the mentioned genotypes needs with priority integrated phytoprotection.

4. Conclusions

Brown rot - *Monilia laxa,* red spot - *Polystigma rubrum*, micotic shoot hole - *Stigmina carpophila* are the dominant fungi pathogens in many plum producing orchards and must be contained using tolerant varieties, resilient rootstocks, modern growing and phytoprotection technologies.

In order to obtain high quality fruits, in further and nowadays plum orchards, use of performing registered varieties is a very important component of the production and marketing chain, therefore, prior to their extension into culture, is necessary test intensively under concrete orchard conditions the most valuable varieties and rootstocks.

The average damages degrees (DD %) and varietal sensitivity index (VSI %) are strong diseases behaviour indicators for each variety released or promoted into the culture and decision tools to design, forecast and apply the phytoprotection programs for each plum producing orchard or nursery.

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Figures

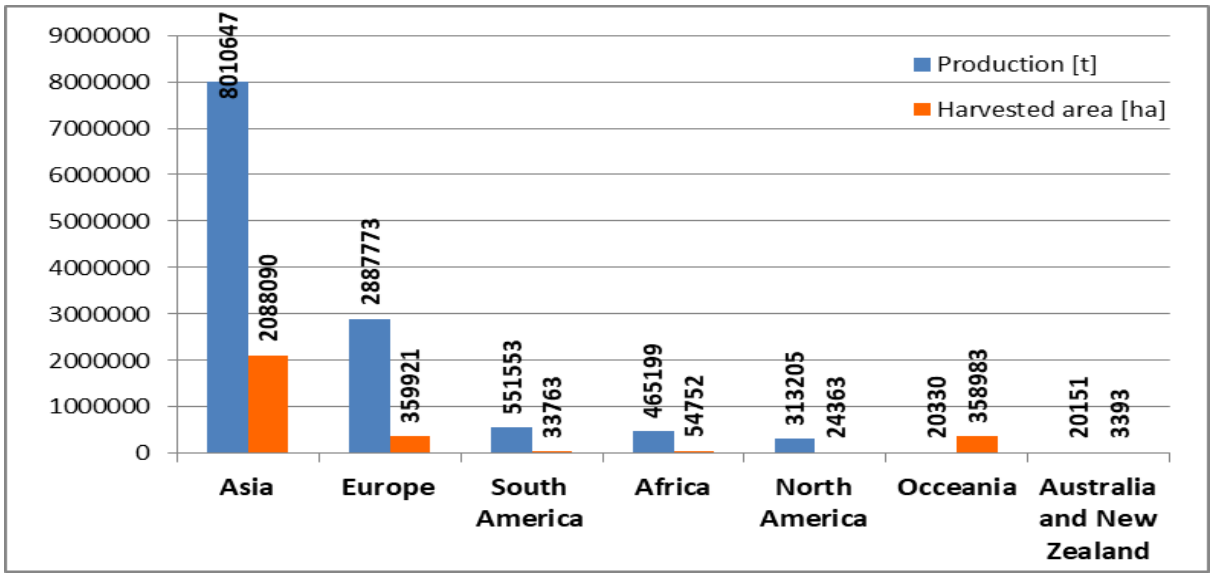

Fig. 1. Plum production and harvested area (2018-2022) in the world

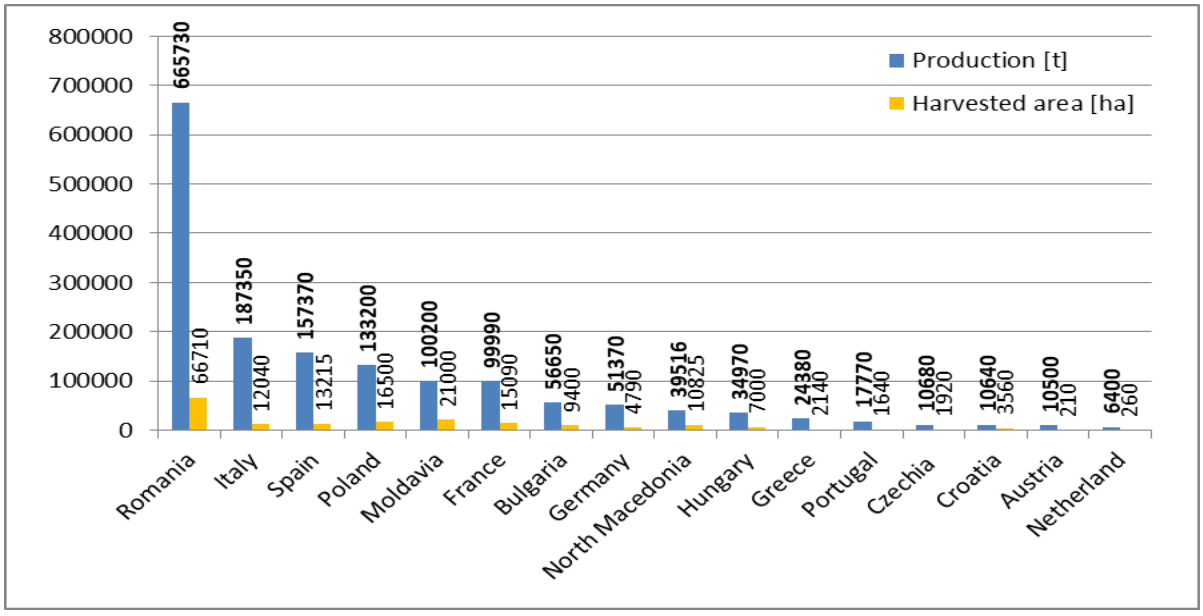

Fig. 2. Plum production and harvested area in Europe in 2022

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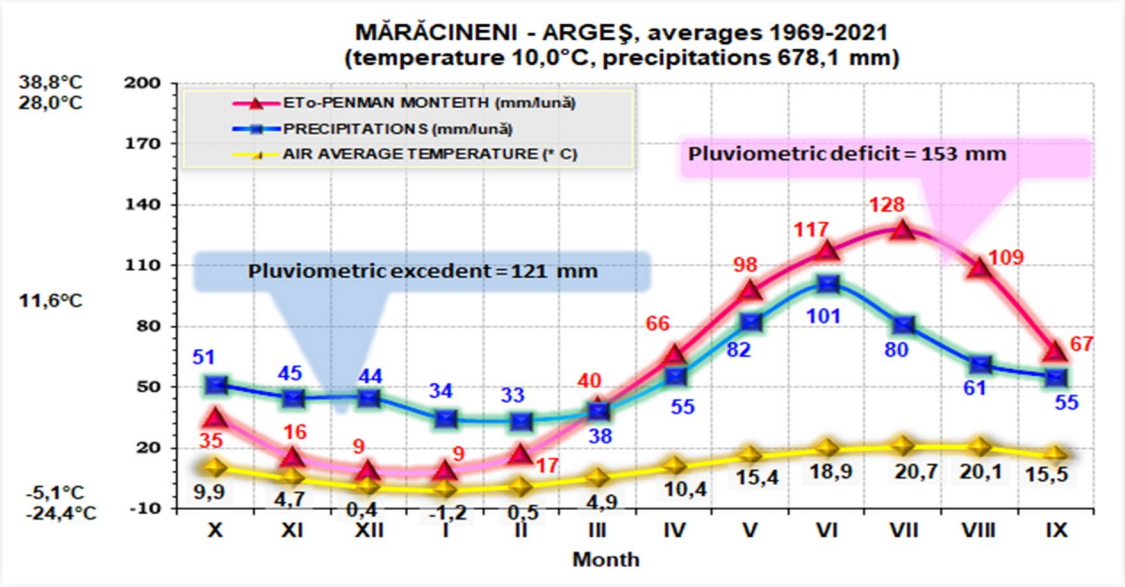

Fig. 3. Climadiagram for the trials site RIFG Pitesti-Romania, Lat. N 44,513; Long. E 24,52; Alt 287m

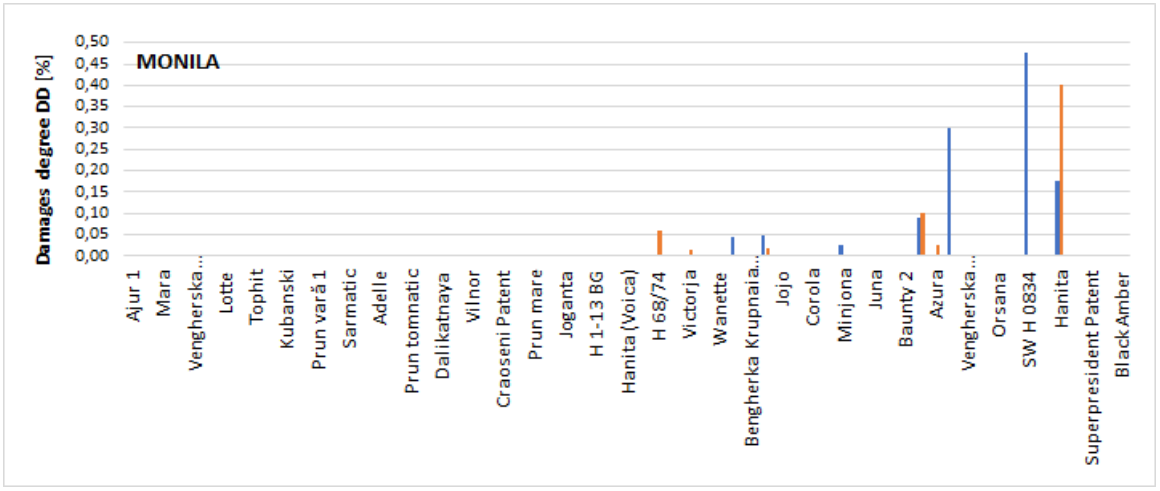

Fig. 4. Behavior of some plum genotypes 4-5 years old on brown rot - *Monilia laxa* attack

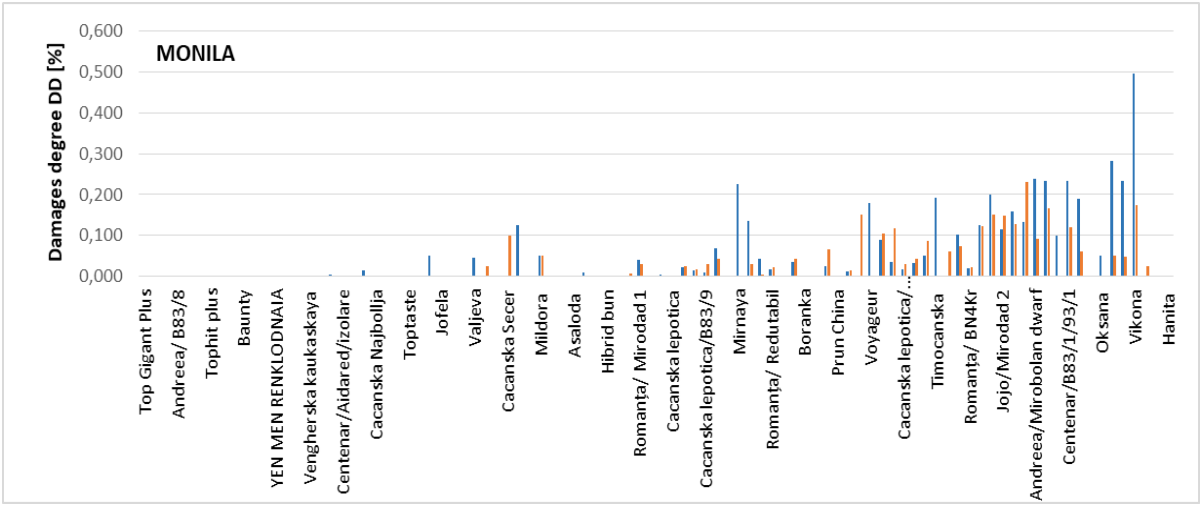

Fig. 5. Behavior of some plum genotypes 6-7 years old on brown rot - *Monilia laxa* attack

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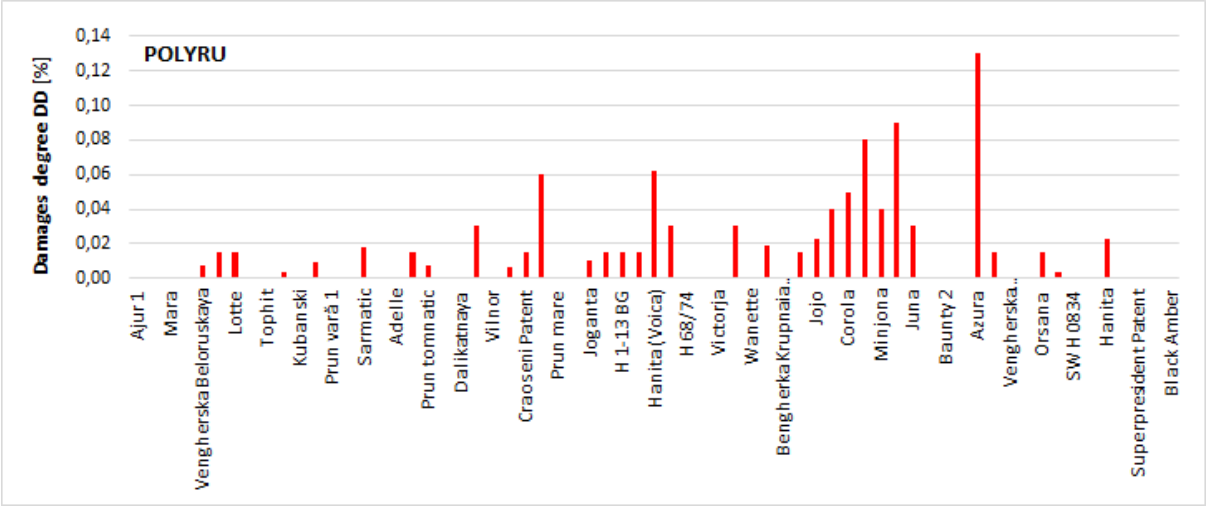

Fig. 6. Behavior of some plum genotypes 4-5 years old on red spot *Polystigma rubrum* attack

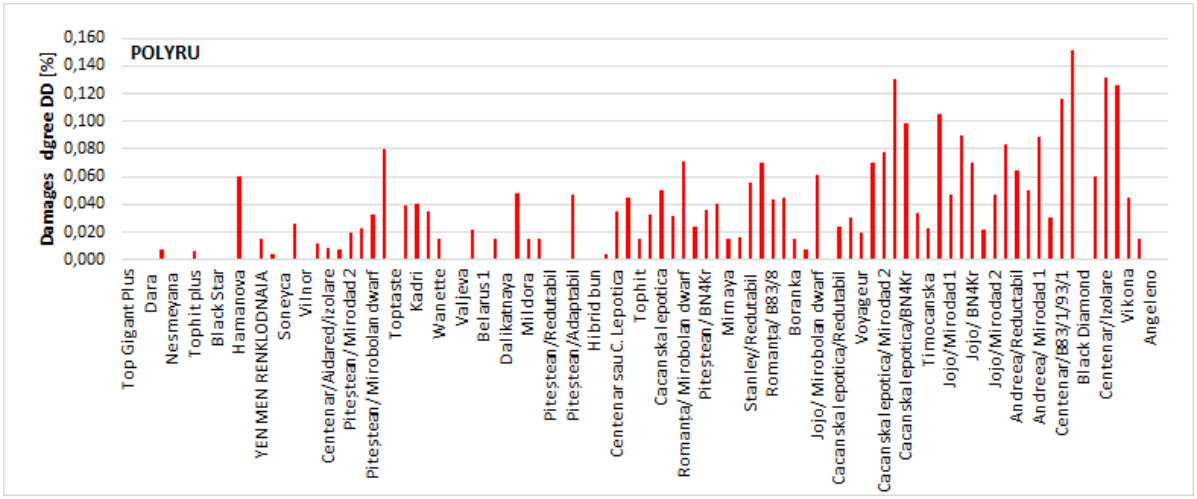

Fig. 7. Behavior of some plum genotypes 6-7 years old on red spot *Polystigma rubrum* attack

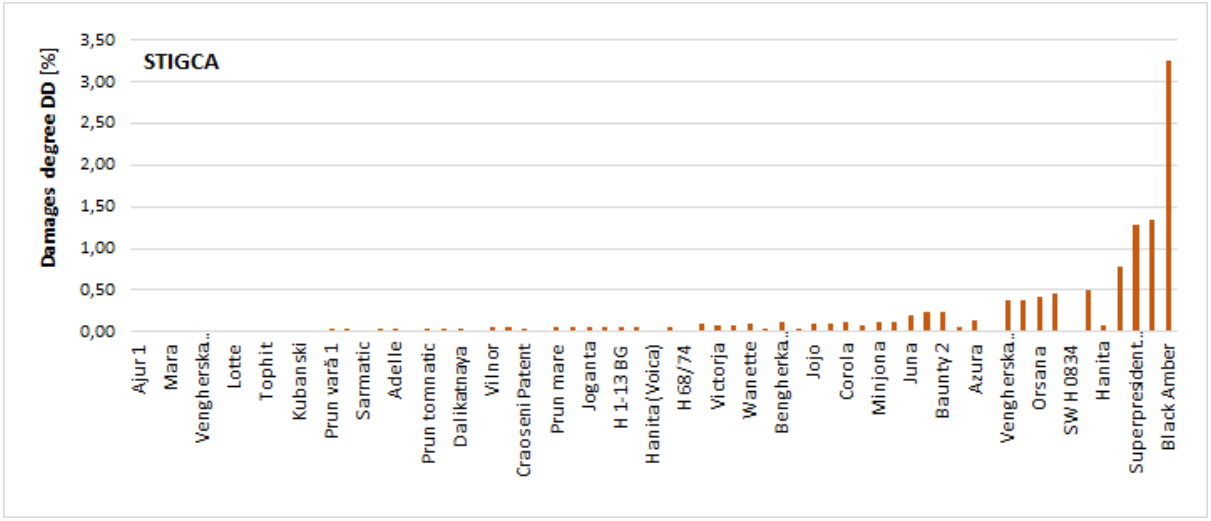

Fig. 8. Behavior of some plum genotypes 4-5 years old on shoot hole *Stigmina carpophylla* attack

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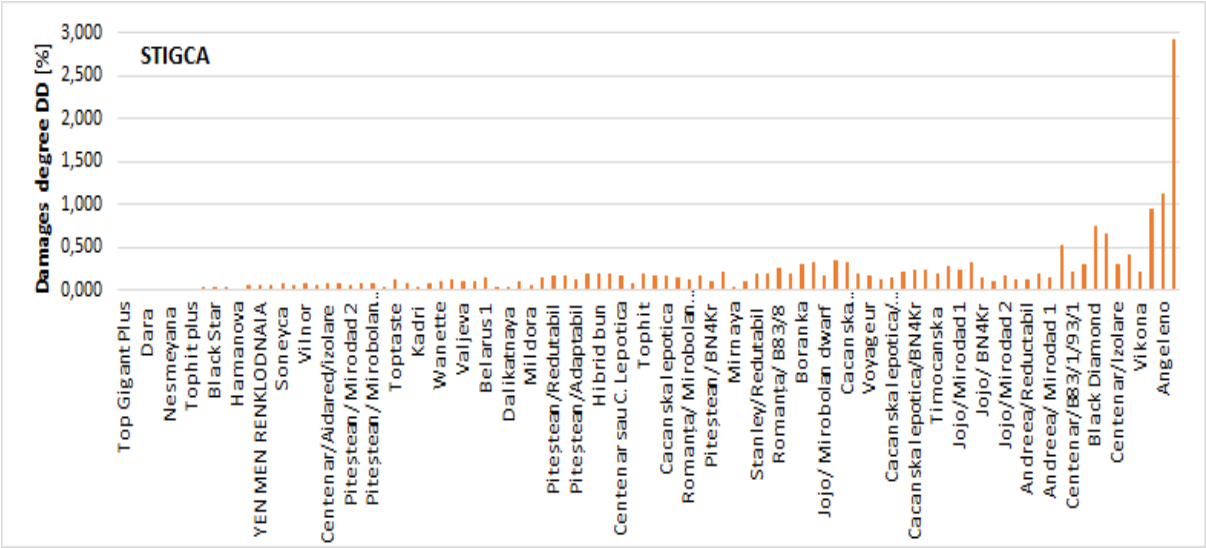

Fig. 9. Behavior of some plum genotypes 6-7 years old on shoot hole *Stigmina carpophylla* attack,

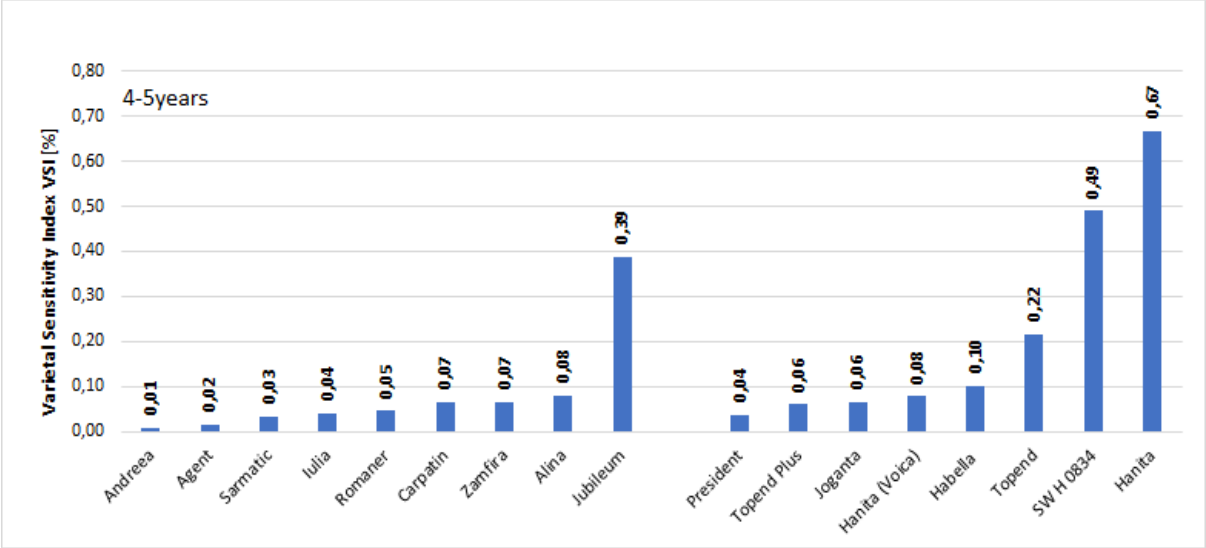

Fig. 10. Varietal sensitivity index of some plum genotypes 4-5 years old to fungal diseases

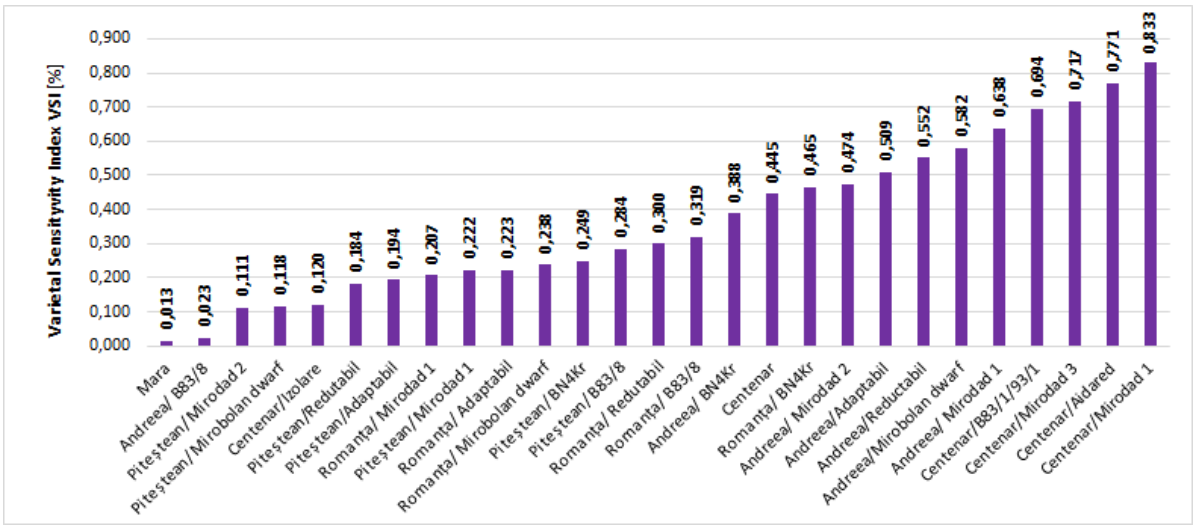

Fig. 11. Varietal sensitivity index of some Romanian plum genotypes 6-7 years old to fungal diseases.

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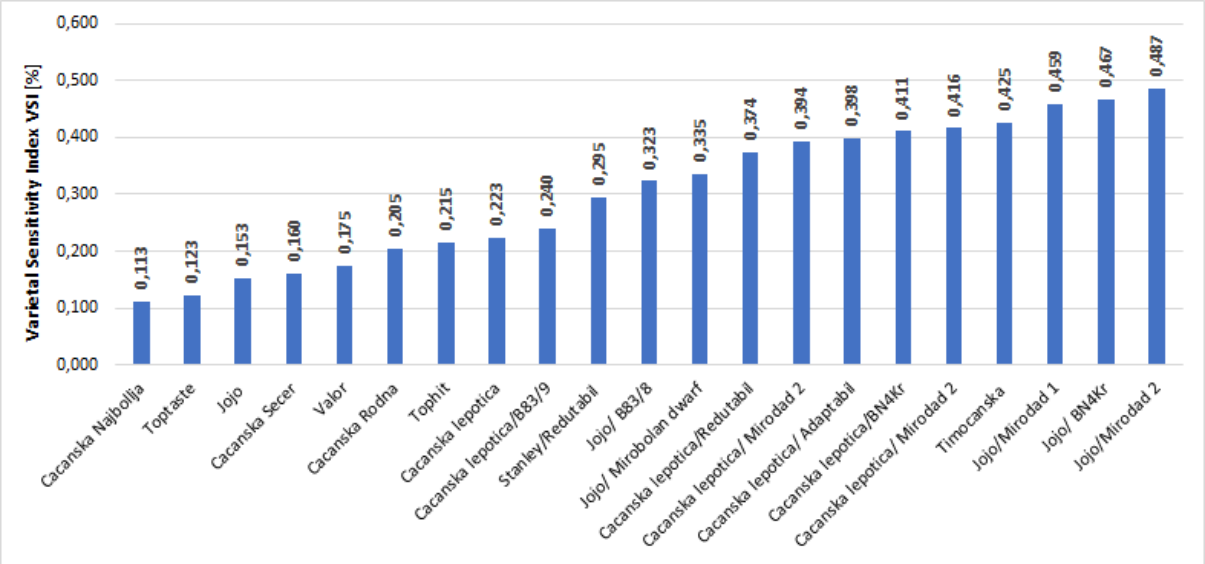

Fig. 12. Varietal sensitivity index of some foreign plum genotypes 6-7 years old to fungal diseases.

Fig. 13. Sensitive plum genotype attacked by brown rot - *Monilia laxa*

Fig. 14. Sensitive plum genotype attacked by Red spot - *Polystigma rubrum*

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Fig. 15. Sensitive plum genotype attacked by micotic shoothole - *Stigmina carpophylla*

Fig. 16. Healthy plum genotype tolerant to main pathogenic fungi