

THE INCIDENCE OF APPLE POWDERY MILDEW IN TRADITIONAL ORCHARDS OF FÂNTÂNELE

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Abstract

*The resistance of apple tree cultivars (*Malus domestica* Borkh.) towards different pests and diseases is relevant for the today breeding programmes. In this respect it is important to access genetic resources from gene banks as well as from traditional apple pools. In Romania such orchards are not very often today but certain remains from the XVIII century can be found especially in Transylvania. The scope of this article is to present the incidence of infestation with apple powdery mildew (i.e. *Podosphaera leucotricha*) for 24 old apple varieties found in Fântânele, Sibiu County. Among the 937 investigated apple specimens, in four different landscape subunits for a three consecutive years (i.e. 2014, 2015, and 2016) three varieties proved to be extremely sensitive (i.e. Golden delicious' 'Grosse Casseler Reinette' and 'Jonathan'). On contrary local varieties proved to be resistant. Also 'Boiken', London Pepping', 'Edelborsdorfer', 'Reinette Ananas', 'Gustav', 'Astrachan Rouge', and 'Red Delicious' proved to resist to the attack of apple powdery mildew.*

Key words: old apple varieties, *Podosphaera leucotricha*, apple, breeding programme, varieties under conservation, landscape

INTRODUCTION

Apple powdery mildew (APM) is due to apple (*Malus domestica* Borkh.) infection with the fungus *Podosphaera leucotricha* and it is recognized among relevant diseases caused by other pathogens (i.e. *Venturia inaequalis*, *Erwinia amylovora*, and *Marssonina coronaria*) affecting both fruit productivity and quality [22]. It is considered today that it attacks especially commercial apple varieties of culinary interest [4; 17]. Once such a disease appears it is well known that generally the producers are interested in developing management solutions for controlling its outbreak especially by using pesticides [8]. Due to commercial constraints, sensitive and resistant apple varieties were long time studied. It was accepted that the resistance against APM is a genetic quantitative trait [17]. Today it is considered that the use of resistant apple cultivars is the best way of maintaining productivity but still climate change effects can do more damage and the diversity of cultivars inside an orchard should re-evaluated [3]. We consider that resources of valuable importance in this regard are traditional orchards that comprises old

varieties and old specimens established for more than 80 years of existing in the same landscape. The age of a specific genotype may express or not different apple resistance responses towards the fungus [12]. Different strategies for fighting against this disease were published [13; 24]. It was also proved that the high diversity of apple varieties, the diversity of species inhabiting the orchard agro-ecosystems, and the diversity inside the landscape may further limit the outbreak and spreading of disease [7]. The scope of this article is to evaluate the incidence of APM in traditional orchards of Fântânele from Sibiu county, Romania that can be considered as a pool of genetic diversity for the future breeding programmes. The investigated orchards have been already described as comprising old apple varieties specimens elder than 80 years [1].

MATERIALS AND METHODS

Place of investigations: the traditional orchards of Fântânele (45°45'23" N and 23°55'28" E) positioned in Sibiu county, Romania, where investigated apple trees found into four landscape sub-units such as:

forest area (800 m altitude), mountain area (1000 m altitude), village area (700 m altitude) and creek area (500 m alt) (Fig.1).

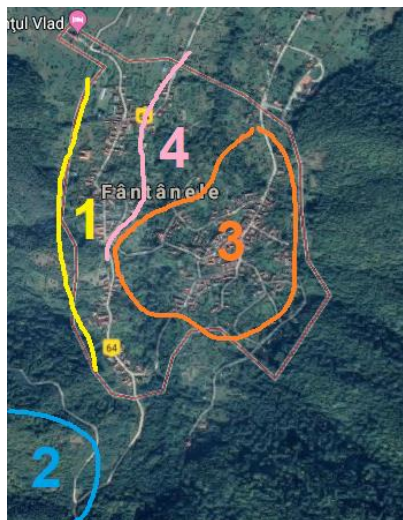


Fig. 1. The landscape sub-units of Fântânele positioned between 700 and 800 m altitude : 1- along the forest, 2- in the mountain at 1000 m, 3 – inside the village and 4 – along the creek (image obtained from www.google map modified by authors).

Method of investigation. Apple powdery mildew (APM) caused by *Podosphaera leucotricha* is easy to be investigated during the wet spring and summer time. The signs are the covering of the new twigs with a white mycelium followed by the falling of leaves (Fig. 2). All apple trees present in the four landscape sub-units have been investigated for the incidence of APM starting with the late May 2014, a wet season of the year up to 2016 (i.e. three consecutive years).



Fig. 2. The general appearance of apple twigs infested by the apple powdery mildew, ‘Golden delicious’ (original).

RESULTS AND DISCUSSIONS

In the apple pool of Fântânele, 937 specimens of 24 old apple varieties have been

investigated for the potential infection with APM as well as for the position of identified apple specimens in the landscape of Fântânele.

‘Belle de Boskoop’. All 84 investigated specimens do not presented signs of infection during the end of May proving they are not sensitive no matter where they are located. Thus, these apple trees were located either in village area either in the border of the creek of the village in close connection with a forest either over 1000 m in the mountain area. Such a large distribution of this variety proves that this cultivar might be relevant as a genetic resource for being further studied for its resistance towards PAM that is in line with other studies [20] (Fig. 2).

‘London Pepping’. Only three specimens have been found (Lat: 45.761154 and Long: 23.925619) that where not infected (Fig. 4). We mention that the specimens were present in the wet areas such as the border of the forest and along the creek of the village. It can be considered as well as moderate resistant considering some previous studies [2]. The narrow distributions of the existing specimens in the area compared to other varieties may further suggest that probably the former specimens have been removed by the outbreak of different other disease.

‘Winter Pearmain’. 44 trees have been found on site also located in different landscapes units such as inside the village or near the creek and the forest of the village. This old apple variety can also be integrated into future commercial orchards (Fig. 5). No infection occurred, or it was too weak to be identified. It is well known that this variety is susceptible for being infected [11] but probability the weather conditions were not favourable for the disease outbreak in this apple pool.

‘Batul-Alma’ or ‘Pomme de Transylvanie’ is among the most popular apple tree in this area and eleven genotypes have already been described [15] (Fig. 6). There have been found 155 specimens in all landscape sub-units of the Fântânele village (i.e. inside village, near the creek and near the surrounding forest).



Fig. 3. Apple variety 'Belle de Boskoop'(original)



Fig. 8. Apple variety 'Edelborsdorfer'(original).



Fig. 4. Apple variety 'London Pepping'(original).



Fig. 9. Apple variety 'Yellow Bellflower'(original).



Fig. 5. Apple variety 'Winter Pearmain'(original).



Fig. 10. Apple variety 'Reinette Bauomann'(original).



Fig. 6. Apple variety 'Batul Alma'(original).



Fig. 11. Apple variety 'Reinette Ananas'(original).



Fig. 7. Apple variety 'Boiken'(original).



Fig. 12. Apple variety 'Gustav'(original).



Fig. 13. Apple variety 'Astrachan Rouge'(original).



Fig. 18. Apple variety 'Starkrimson'(original).



Fig. 14. Apple variety 'Red Delicious'(original).



Fig. 19. Apple variety 'Roter Stettiner'(original).



Fig. 15. Apple variety 'Nemes Sovari Alma'(original).



Fig. 20. Apple variety 'Locale d'ete'(original).



Fig. 16. Apple variety 'Poynik alma'(original).



Fig. 21. Apple variety 'Jonathan'(original).



Fig. 17. Apple variety 'Reinette du Canada'(original).



Fig. 22. Apple variety 'Local Florin'(original).

All specimens, identified in all four landscape sub-units, appear to be resistant to APM supporting other studies results [19].

‘Boiken’ Only 18 specimens have been identified, inside the village and all of them free of the pathogen (Fig. 7). This variety was located in different landscape sub-units of the village. However, the variety is known as susceptible [6] and their restrained habitat may be due to the loss during its history of cultivation in the region or due to the large diversity in varieties in this apple pool.

‘Edelborsdorfer’ is a moderate popular old variety for Fântânele also and 29 specimens have been identified all of them not infected (Fig. 8). Also, these specimens have been located in different landscape sub-units (i.e. inside the village, close to the forest and close to the creek). They may be considered as not sensitive to the APM as it was long time before considered as a resistant variety [5].

‘Yellow Bellflower’ was identified in the mountain area as well as in the nearby forest area of the village. Of 10 specimens no one was found to be infected (Fig. 9). The variety is sterile and is of economic interest for long time even it was considered as being susceptible towards the APM [10].

‘Reinette Bauomann’ is a popular apple tree variety in this village and found in all landscape sub-units from the village to the creek, forest and to higher altitude in the mountain area. 61 specimens have been identified and no one was infected, or not visible infection was found (Fig. 10). This variety can be considered as resistant towards APM attack for local conditions and is in line with other studies in Transylvania [21].

‘Reinette Ananas’. Only two specimens have been identified in the creek area of the village. However, these apple trees were not infested even they were identified in a warm wet climate (Fig. 11). In Serbia this variety was considered as moderate resistant [2].

‘Gustav’. 28 specimens have been identified and no infection was observed during our investigations (Fig. 12). These were spread in all landscape sub-units such as from the mountain through the village along the creeks and close to the forest. However it is

considered as moderate resistant towards the APM based on previous results [21].

‘Astrachan Rouge’ is another rare old variety and only one specimen was found in the area of the village. However, it was not infected (Fig. 13). Other 4 specimens were found in Sibiel and Vale (two neighbouring villages positioned in the northern part of Fântânele) and also free of the pathogen. The variety is considered as moderate resistant towards APM [2].

‘Red Delicious’. 27 specimens have been found in all village subunits from the mountain area inside the village, along the creek and near the forest (Fig. 14). No one was infected and proved to be moderate resistant in line with previous studies [21].

‘Nemes Sovari Alma’ or **‘Noble de Sovar’** is a popular old variety. 49 specimens have been identified spread in all screened orchards and identified landscape sub-units (Fig. 15). No one was infected proving a moderate resistance according to previous studies [21].

‘Ponyik alma’ is a very popular old variety. 86 specimens have been identified and all of them of high vigour (Fig. 16). No one was infected even they are occupying all types of landscape sub-units. The variety was not yet characterized for its resistance against APM being characteristic for Transylvania [18].

‘Reinette Canada’ is a rare old variety 13 specimens have been identified in all landscape sub-units (Fig. 17). No infection was observed and support previous studies considering it as a moderate resistant variety [21].

‘Starkrimson’ is a rare popular old variety (Fig. 18). Only 21 specimens have been identified spread in all landscape sub-units. No infection was identified supporting previous studies results obtained in Transylvania [21].

‘Roter Stettiner’ or **‘Rouge de Stetin’** is also a popular old variety (Fig. 19). 42 specimens have been identified in all landscape sub-units (mountain, forest, village and creek). No infection was found and it support previous results [23].

‘Locale d'ete’. Not very popular old apple landrace (Fig. 20). One specimen that was not infected was found in the village area.



Fig. 23. Apple variety 'Local of Cacova'(original).



Fig. 24. Apple variety 'Local Baia Mare'(original).



Fig. 25. Apple variety 'Golden delicious'(original).



Fig. 26. Apple variety 'Grosse Casseler Reinette'(original).

'Jonathan'. It was the most popular old variety (Fig. 21). 205 specimens were identified and all of them were infected. Also, this variety was identified in all landscape sub-units of the region. This old variety is most susceptible to be infected to the *Podosphaera leucotricha* and it is in line with previous studies [9; 14; 21].

'Local Florin' is a popular local apple variety (Fig. 22). 29 specimens have been identified in all landscape sub-units and no infection was found.

'Local of Cacova' is a local variety not very popular but producing small red apple fruits. Only two specimens have been found that proved to be not infected (Fig. 23).

'Local Baia Mare' were not very popular (Fig. 24). 10 specimens have been identified in all types of landscapes sub-units and they proved not to be infected.

'Golden delicious' is a rare old variety for the area (Fig. 25). 21 specimens have been found in all landscape sub-units of the village. This was also identified in Sibiel village. However, 100% of the identified specimens have been infected being in line with previous studies [16; 21].

'Grosse Casseler Reinette' is a very rare old apple variety (Fig. 26). Only 3 specimens have been identified inside the village and all of them have been infected proving their low resistance [10].

CONCLUSIONS

The analysis of these results shows that three old apple varieties, over 80 years old, were infected with APM such as the following: 'Jonathan', 'Golden delicious', and 'Grosse Casseler Reinette'. All local apples varieties showed resistance towards the pathogen. Some moderate sensitive varieties such as 'Boiken', 'London Pepping', 'Edelborsdorfer', 'Reinette Ananas', 'Gustav', 'Astrachan Rouge', and 'Red Delicious' proved to have good conditions to fight against this disease. The high diversity in cultivars as well as in the landscape, probably are relevant factors in supporting the fight balance between the apple three and pathogens. All these old varieties should be red listed for their relevance in the conservation of genetic resources. These results further support the need for official preservation of traditional orchards in Romania for the future apple breeding programme.

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