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ASPECTS REGARDING THE PHYTOSANITARY SITUATION OF AN UNTENDED APPLE ORCHARD

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Abstract

Romania, an European country in which pomiculture is of a main significance, especially from an economic point of view, is well represented by a diversity of species, amongst which the apple (Malus domestica) plays a significant role when it comes to quality production and thus economic profit. This paper aims to look at the main harming agents of the apple at the Rusciori Farm, a plantation where the apple cannot turn its genetic production material to advantage, given the interference of multiple restrictive factors, especially vegetal and animal pests that cause significant damage, thus leading to a qualitative and quantitive decrease in production due to the deterioration of the commercial aspect of the fruit. The main pathogens for apples are those that produce mycoses; and amongst mycoses the most wide-spread ones are mildew (Podosphaera leucotricha Ell. and Ev. Salm*), scab disease (Venturia inequalis* Cooke Wint.*), brown fruit rots (Monilinia fructigena* Honey*) and twig cankers (Nectria galligena* Bres.*); all of them causing significant damage under favorable environmental conditions. Although the orchard in the present study is in decline, not all trees show obvious aging signs, therefore a total land clearing does not come into question. This paper attempts to suggest efficient solutions for prelonging the age of those trees that still promise economic productivity.*

Key words: apple, mycosis, crop loss, plant protection management

INTRODUCTION

Apple trees require permanent attendance and attention in order to render large crops of high quality fruit. Without regular tending some trees may die prematurely. It can be frustrating when the fruit harvest is damaged as a result of diseases and pests. This is the case of the orchard at which we look at in the present study; and which has not seen any maintenance work in almost 10 years. Therefore, the question one has to ask is how efficient this orchard is and whether it can be revigorated. In order to discuss the rehabilitation and revigoration of this orchard, one has to know and evaluate its phytosanitary state; and only after finding certain answers can one evaluate its status realistically and determine whether its revigoration would be useful in increasing its productivity to the degree of the farm’s heyday.

As mentioned before, all observations have been made on the surface of the apple orchard of the Rusciori Farm. The farm is located in the Sibiu basin; and belongs to the territory of Şura Mică, thus being a part of the fruit tree region IV, an area favorable to apple cultures, but also to several pathogens [17]. The farm has a surface of 39.29 hectares of infield, out of which 86% has trees of the Starkrimson, Wagner Premiat, Jonathan, Red Melba and Golden delicious varieties, laid out in three parcels. The aim of the paper: to identify pests and other harming agents affecting the apple culture in this particular orchard, thus enabling the finding of suggestions regarding their integrated management.

There is a series of plant diseases occurring as a general rule every year, in both orchards and gardens. Meteorological conditions influence to a great extent not only the occurrence, but also the evolution and severity of such diseases [18]. Therefore, these plant diseases are much more difficult to contain during warm and humid years [22], [25].

Mildew, caused by the *Podosphaera leucotricha* fungus (Ell. and Ev.) Salm., occurs in all regions in which apple trees are cultivated worldwide; and represents the most

frequent and malign disease [6], [22] on the orchard analysed in this study. The disease generates economic losses by affecting both the trees' vigor and the production of blossom and fruit [16], [13]. In our case-study orchard, mildew is a chronic recurring issue, given that the lack of an appropriate tending of the orchard determines the disease levels of a particular season to increase the percentage of infected tree buds during the following season, thus also the decrease in or even the complete loss of fruit production for the following season. As symptoms, this fungus appears in the form of small felt cushions on young buds, leaves, flowers and fruit; and then as a white powder (Photo 1).

Besides mildew, other occurring diseases affecting the orchard are scab (Photo 2), moniliosis, open canker and – with a frequency of 100% on all trees regardless of their variety – mosses and lichens.

MATERIALS AND METHODS

The apple tree orchard analysed in this study is located in the Sibiu basin, in a region with a mild continental climate and having climate and soil conditions that are favorable to apple production, thus reducing the risk of production instability. The physical, chemical and biological characteristics of the soil – as a brown soil of different varieties – are more than adequate.

Temperatures are within limits during the vegetation period, the median annual temperature for the last 100 years being of 8.9 degrees Celsius. Although during the last years the median annual temperature has been above the median of the last 100 years, temperature is not a limitative factor in the region.

The annual precipitation median is of 662 mm, but the the precipitation repartition throughout a given year is uneven, having caused periods of drought, especially during the last ten years. Determined by the geographic position, in the Sibiu basin, due to the Olt chute and terraces, the winds of a medium speed and frequence blow from northwest, whereas local winds are mountain breezes and the so-called Great Wind (Snow-eater), at the beginning of spring, which melts the snow and is thus important for agricultural activities [25].

For an analysis of the apple orchard from a phytosanitary perspective, as well as for the formulation of final conclusions regarding the rehabilitation of the plantation, periodic inspections are necessary, not only during the vegetation period, but also during vegetative repose. The time frame in which studies were performed on the farm were the years 2014-2016, during which pests and their attacks on plant organs were monitored and identified. Moreover, samples for an ulterior identification were also harvested, a soil analysis was performed, crop damages were evaluated and a complex of measures was suggested as efficient solutions to prolong the life and productivity of those trees.

RESULTS AND DISCUSSIONS

In agro-ecosystems man modifies the trophic relationships between populations, encouraging the autotrophic producers (cultured plants), and limiting the consumers and those autotrophic producers that are useless to man [7]; something that has not happened in the orchard under study for the past ten years.

The knowledge of fungal biodiversity and of its biological characteristics is crucial for taking decisions and deciding on plant protection policies based on scientific research. Systematic studies are the basis for the knowledge on biodiversity and they include the discovery and description of species [6], as well as their monitoring, sampling of the attack and loss evaluation.

At the Rusciori tree farm, besides the lack of treatment against pests for the last ten years, no phytosanitary hygiene measures, cropping, fructification or agro-technical measures have been taken either. Therefore, the percentage of affected fruit is of approx. 90%, whereas the degree of harm when it comes to the trees is from moderate to severe and extremely severe, in the case of all vegetal or animal pests identified in the orchard.

The most significant pathogens identified in the orchard are: *Podosphaera leucotricha*

(Photo 1), *Venturia inequalis* (Photo 2), *Monilinia fructigena* (Photo 4), si *Nectria galligena* (Photo 3), as well as mosses and lichens (Photo 5). The state of mildew in the orchard is represented in the next table (Table 1).

As visible in Table 1, all apple tree varieties have been attacked, the most sensitive one being Jonathan (Photo 1), whose attacked blossom dried out without providing fruit. Thus, being a variety sensitive to mildew, this type of attack led to significant crop losses (up to 100%).

Tabel 1. Frequency of mildew attack on apple varieties

Variety	Weak attack	Medium attack	Powerful attack	Extremely powerful attack
Starkrimson	X			
Wagner Premiat	X			
Jonathan				X
Red Melba	X			
Golden delicious		X		

It might be asserted that those apple varieties having a thin peel are less resistant to mildew [5].

Table 2. Pathogens and range of attack

Variety	Measure unit	Pathogen	Range of attack / density
STARKRIM-SON	Fr. GA	*Podosphaera leucotricha* Powdery Mildew of Apple	Weak attack
	Pomi %	Moss/lichens	100%
WAGNER PREMIAT	Fr. GA	*Podosphaera leucotricha* Powdery Mildew of Apple	Weak attack
	Pomi %	Moss/lichens	100%
JONATHAN	Fr. GA	*Podosphaera leucotricha* Powdery Mildew of Apple	Extremely powerful attack
	Pomi %	Moss/lichens	100%
RED MELBA	Fr. GA	*Podosphaera leucotricha* Powdery Mildew of Apple	Weak attack
	Pomi %	Moss/lichens	100%
GOLDEN	Fr. GA	*Podosphaera leucotricha* Powdery Mildew of Apple	Medium attack
	Pomi %	Moss/lichens	100%
	Fr. GA	*Venturia inaequalis* – Apple scab	Weak attack

According to our own observations, the most sensitive varieties to mildew attacks are Jonathan (strong attack) and Golden Delicious (medium attack), whereas when it comes to scab, Golden Delicious was most heavily affected. It ought to be mentioned here that scab was only noticed on leaves and twigs, given that fruit were never produced, also due to the attack of ladybeetles.

Photo 1. Powdery Mildew of Apple (original photo)

It is beyond doubt that – unless necessary measures are taken – the scab disease will spread to the other varieties in the orchard, which are more resistant but are not immune [26].

Photo 2. Apple scab (original photo)

Photo 3. Nectria canker on Apple (original photo)

Photo 4. Moniliosis on Apple (original photo)

It ought to be mentioned as well that numerous plants – from all varieties – were affected by cankers (*Nectria galligena*).
Unattended orchards or farms with old trees are usually characterized by a high occurrence of lichens and mosses on the trees' trunks and twigs; and the same goes for the Rusciori orchard, in which the occurrence of mosses and lichens on apple trees is of 100%. These types of pests are very harmful to trees, leading to low production, low quality fruit and eventually causing twigs or even the entire tree to dry out.Furthermore, they represent a favorable environment for pests [9], are indicators declined orchards [27] and the worst scenario is when lichens attack main twigs, so the thickest ones that cannot be cut off – as in the case of the apple trees at the Rusciori farm. The only advantage of lichens is the fact that they indicate a clean air, rich in oxygen with hardly any pollution [20].

Photo 5. Moss and lichens (original photo)

CONCLUSIONS

In conclusion, the main question is whether the necessary time and financing to renovate a currently untended orchard can be justified, given the fact that in 2014 and 2015 there was no harvest due to the powerful attacks by vegetal and animal pests; the most sensitive apple variety being Jonathan.
The suggested answer is that the orchard of the Rusciori farm is a declining one, but although the apple trees have been attacked by a multitude of pathogens and pests, not all trees show obvious signs of aging; and therefore a total land clearing does not come into question. The cultivated varieties are highly demanded in the region , both for their consumption as fresh produce and for their processing; and there are efficient solutions to lengthen the life of those trees which still promise economic productions: the riddance of exhausted trees; radical regeneration croppings of the main branches by removing half of the twigs' extremities; scraping and brushing of trunks and twigs, as well as their whiting as a measure against lichens and mosses; fertilization of decaying trees, by using moderate dosage of nitrogen, phosphorus and potassium or conpost heap [22]; decreasing infection sources by a multitude of agro-phytotechnical measures: deep autumn tillages, used to bury the attacked leaves having a large number of germs [21] or the burning of affected leaves and dry twigs as a means to decrease the source of infection. Urea spraying favorizes leaves to come off, so by removing the leaves the harm is noticeably reduced. The elimination of contamination sources (attacked sprouts, mummified fruit, etc.) can be achieved by the following measures: ploughing between lines; mulching or herbicidation between lines in order to destroy weeds; avoiding lesions during harvesting; triage of the fruit before storing; planning and performing a programme of phytosanitary treatments during vegetative repose and during the vegetation period, treatments that constitute chemical protection [11], [14], a fundamental measure often applied in apple orchards. The treatments are performed after

recommendation from the advisory/warning stations, by respecting and applying the indications from the warning bulletins, together with controlling those pests that provoke damages to the fruit.

Protection measures against pathogens represent important chains in the context of the culture technology of cultivated plants [8]; and they contribute to the saving of considerable crop quantities and the provision of high quality products.

Special attention must be given to integrated protection [1], by the combination of all preventive and curative measures and methods [13], [16], and if possible their integration in the plant culture technology, striving to attain a healthy culture, while protecting the environment. Due to the multitude of pests occurring on apple plantations, individual control methods cannot be successful [2]. Therefore, it is advisable to combine chemical means with other compatible methods [22].

The complex of measures (Fig.1) having real consequences on decreasing the attack of pathogens, obtaining high quality fruit, with increased possibilities of preservation and efficiency, defines the modern concept of integrated protection [24], [15], [23].

Prevention and protection methods are established according to pest species [5], [12], [16], [10], orchard surface, technical possibilities as well as ecological [3], [6] or agro-technical conditions [15], [16], [4].

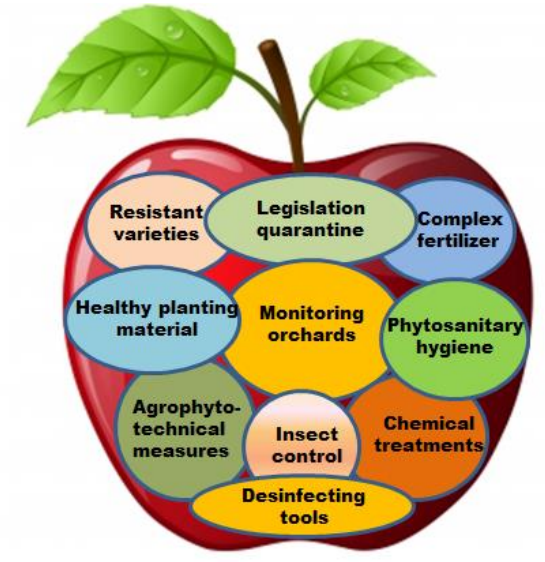

Fig. 1. Integrated protection scheme (original)

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