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SYSTEMATIZATION OF CHLOROTIC MANIFESTATIONS ON POME AND DRUPACEOUS FRUIT PLANT SPECIES IN BULGARIA

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Abstract

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The report presents data on chlorotic manifestations, observed within 2004 – 2013 on pome and drupaceous fruit species grown in different areas of Bulgaria. Those manifestations were systematized in view of their role as a key for further investigations on their etiology and the possibilities for their prevention and treatment.

The data were collected during the inspection of fruit orchards that had been created either for industrial fruit production or family consumption. The inspection, marking of the infected trees, compiling an anamnesis for the separate pathological manifestations, collecting samples for laboratory testing and the sample tests present a research process.

The established manifestations were generally classified as infectious and noninfectious, according to their etiology. The agents of the infectious ones were fungi and viruses and noninfectious were caused by the adverse effect of abiotic factors such as excess soil humidity and obstruction of nutrient assimilation. Moreover, abiotic factors like excess soil humidity exposed the root system to the attack of fungal pathogens.

Key words: chlorosis, pome and drupaceous fruit trees

Introduction

Chlorosis is a well known disease among fruit farmers and its economic importance has focused scientific research on its etiology. The accumulated information showed that the causes of chlorosis could be defined generally as infectious and noninfectious.

The first group comprised the viruses, phytoplasmas and other similar agents of infection and the second – the disturbances in the nutrient regime of fruit plants, ruined water balance, increase of soil pH and genetic anomalies, etc.

Chlorosis control calls for Good Agricultural Practice (GAP) in fruit plantations. Any negligence in the applied agrotechnologies might result in the strong chlorotic damage of the fruit trees and economic losses to fruit growers. At the first symptoms of chlorosis, the fruit farmers should look for assistance and advice from the qualified experts of the territorial units of the Bulgarian Food Safety Agency (BFSA) of the Ministry of Agriculture, who are responsible for plant disease and pest control, among other obligations. Further investigations concerning accurate diagnosis could be recommended for accomplishment in the scientific units[1].

The timely disease diagnosis is of major importance to chlorosis control and to minimizing the losses it incurs. Diagnosis is a process that includes a number of activities, such as investigation in the affected orchards, marking the infected trees, making an anamnesis of the separate pathological manifestations, collecting samples for laboratory tests and testing them, etc. In real life, the process is never complete for one reason or another. However, in a critical situation, the fruit growers will get a useful piece of advice, highly reliable and based on timely diagnosis.

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The objective of the present report was to systematize the accumulated information on the chlorotic manifestations in pome and drupaceous fruit trees in order to optimize the process of diagnosis.

Material and Methods

The study encompassed the following fruit species: plum, sour cherry, cherry, apricot, apple, pear, medlar and almond grown in different areas of the country, where the investigations took place either planned in a preliminary scientific program or as a response to signals and samples of the above mentioned fruit species, received by the institute.[2]

In case of chlorotic manifestations, the attention was focused on facts and events of meteorological character for the specified area, the species in the fruit plantation and the agrotechnology applied, including fertilization and disease control products, etc.

The chlorotic manifestations were compared according to Isaeva (1971), Ogawa et al. (1995), Jeffers and Wilcox (1997), Slykhuis (1997), Schurtleff and Averre **(**1997) and Yanase et al. (1997).

The systematization was based on the following indexes:

- extend and frequency of manifestation on the leaf lamina;
- type of manifestation (systemic or partial);
- location of manifestation on the tree canopy;
- location and frequency of manifestation in the plantation.

The investigation also accounted for accompanying pathological symptoms in cases of severe infection such as tissue and organ necrosis and suppressed growth, etc.

In some cases of suspected infectious chlorosis young immature leaves and blossoms were collected for an enzyme linked immunosorbent assay – double antibody sandwich (DAS - ELISA).

DAS ELISA, intended to identify the prunus necrotic ringspot virus (PNRV), prune dwarf virus (PDV) and apple mosaic virus (ApMV), was performed with the diagnosis reagents of the company LOEWE as per the instructions provided by the company.

Results and Discussion

According to the data collected during the investigations as well as the signals received by the institute, chlorotic manifestations were identified in the plum, sour cherry, cherry, apricot, apple, pear, medlar and almond.

Their identification by regions and variation by the trees of different fruit species is given in Table 1. The biggest diversity was observed in the apple tree where the chlorotic manifestations varied from mosaic leaf spots to complete chlorosis (yellowing) that spread on leaf lamina veins as well.

In a newly planted garden in the area of Skrat village, Petrich municipality, the fully developed leaves of some trees were pale green and became rusty red during late summer after continuous and heavy rainfall at the beginning of the vegetative period. The chlorosis appearance and suppressed growth persisted during the subsequent vegetation. Some of the ailing trees were eradicated because of the lack of recovery symptoms and even decease. The damages to the root system of some eradicated trees resembled phytophthora root, crown and collar. There was a clear line between the damaged and healthy tissue. When the root system had not decayed, no necrosis was found in the area of adhesion between the graft and rootstock (Gonsales**,** 1997).

The established symptoms corresponded to the ones reported by Jeffers and Wilcox (1997), Nakova (2003) and Nakova (2011). The presence of *Phytophthora* infection was confirmed by the laboratory test as well[3].

Several trees with mosaic on the leaves, resembling apple mosaic (ApMV) (Trifonov, 1972) or partial albinism (panashure) (Markov et al., 1989) were found in the same garden. The virus test proved the presence of virus infection[4]. In the observed case of albinism chlorotic was affected the lower parts of the leaf lamina (partial albinism).

The complete chlorosis might infect the leaves of separate branches or the whole canopy, accompanied by branch drying in pear and medlar also known as “dry twigs”. Due to the lack of adequate pruning, some branches of the old apple trees with very dense canopy had distinct chlorotic leaves (Plates 1 – 3).

In sour cherry and cherry, yellowing is most often observed on the leaves of the lower part of the canopy when it is too dense due to the lack of pruning for shaping and thinning. Complete chlorosis covered the whole leaf lamina, including leaf veins. This was observed on all leaves of the single branches and even the whole tree canopy. It kind of chlorosis could spread easily in years with abundant rainfall during the first half of the vegetation and the affected leaves could drop as early as the end of spring or beginning of summer. Sometimes complete chlorosis is accompanied with drying of branch tips.

In plum, complete chlorosis was manifested on the twig tips of young trees, as well as on some skeleton branches in

[2] The Plant Protection Institute was in the structure of the National Service for Plant Protection within 2003 – 2010 year. Today it is part of the Institute of Soil Science, Agrotechnologies and Plant Protection „Nikola Pushkarov“, Sofia.

[3] Vachev, Ts. (unpublished).

[4] Stoev, A. (unpublished).

Plate 1. Initial chlorosis on apple tree

Plate 3. Defoliation of twigs

Plate 2. Severe chlorosis on pear tree

Plate 4. Healthy apple tree

the canopy of old trees. Other old trees showed symptoms of the silver leaf disease. Some necrotic sectors were identified in old trees with chlorosis and silver leaf. The results of the test of chlorotic plum samples for PNRV и PDV were negative.

In apricot, the chlorotic manifestations varied from leaf fading, accompanied by weaker or stronger wilting, to yellowing with necrotic spots and drying. Some branches or even whole trees with the described symptoms died during

the first half of the vegetation. This pathological phenomenon has been defined as apoplexy in specialized literature (Videnov et al., 1983).

Chlorosis could be a symptom of bud failure in almond. This was established in a new plantation in the area of Burgas, where clusters of pale green leaves on bare twigs grew in contrast with the leaves of healthy branches and trees.

The results of the laboratory tests showed that the trees with bud failure were infected with PNRV, considered a possible pathogen for this disease in specialized literature (Stoev, 2012).

The chemotherapy trials gave a very good positive result with the application of Sekvestren and Lactofol Fe in severe systemic chlorosis in apple, pear and medlar (Stoev and Filipov, 2013).

Good farming practices are of essential importance for chlorosis prevention, namely suitable location, good drainage, reserve fertilization, virus free plant material, type of orchard that requires a certain rootstock, soil cultivation during vegetation etc (Trifonov, 1972; Trachev et al., 1975; Stoilov, 1977; Stanchev et al., 1982; Lecheva et al., 2006). The use of chemotherapeutic products is an extreme measure for saving the fruit trees in severe cases of noninfectious chlorosis (Videnov et al., 1983; Stoev and Filipov, 2013).

Conclusions

The chlorotic manifestations in pome and drupaceous fruit species, grown in Bulgaria, have different etiology. They can be indicators of dangerous diseases like Phytophthora rot and apoplexy that are fatal for the infected trees. The complete noninfectious chlorosis could cause the destruction of separate branches or whole trees as well but timely diagnosis is essential for its treatment. The most efficient measure for chlorosis control is prevention by means of Good Agricultural Practice. The chemotherapy of noninfectious chlorosis should be regarded as an extreme measure against the severe damage or dying of the infected trees.

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