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## **TUBERCULOSIS PATHOLOGY OF *FRAXINUS EXCELSIOR* L. IN UKRAINE**

Recent reports of deteriorating deterioration of the sanitary condition and the dieback of *Fraxinus excelsior* in more than 30 European countries have spread and alarmed scientists and practitioners of the forestry industry, and have given rise to controversy over its causes.

The mass dieback of *F. excelsior* was first recorded in the early 1990s in northeastern Poland and Lithuania (according to the latest data, today the disease affects more than 30 thousand hectares or 60 % of the entire area of ash stands) (Gil et al., 2017). The disease then spread north to Latvia and Estonia (Matisone et al., 2018). In 2002, this disease was first reported in Germany and Sweden (in 2010, common ash was included in the Red Book of Sweden) (Langer 2017), in 2004 in the Czech Republic, Slovakia, Finland (Jankovský & Holdenrieder, 2009), and Denmark, and 2005 in Austria (Halmschlager et al., 2008). Subsequently, in 2007, ash dieback spread to Hungary, Slovenia, and Norway (Talgø 2009). In 2008, the disease reached France (Husson 2011), in 2009 – Italy and Greece (Ogris 2010), where it caused massive deaths of trees. Recent reports on the noted pathology of *F. excelsior* were received from Belgium (Chandelier 2011), the Netherlands, England, and Ireland (EPPO 2020). Ash trees are now dieback in 30 European countries. Programs of countries where signs of ash dieback have been identified, aimed at identifying the origin of the pathogen, assessing its impact on forests, developing methods for diagnosing and conducting forestry in affected forests, including in the direction of the selection of ash for resistance to pathogens (EPPO 2020).

Now the degradation and mass dieback of ash stands has reached a global level and is noted practically throughout the range of many ash species, including *F. excelsior*. From different parts of the planet, there are reports of similar symptoms of pathology. Based on research, several possible reasons have been put forward.

The pathology of *F. excelsior* L. is associated with various factors – micromycetes (Kowalski & Holdenrieder, 2009; Vasaitis & Enderle, 2017; Díaz-Yáñez et al., 2020), bacteria (Schlegel et al., 2016; Goychuk et al., 2020), nematodes (Ryss & Polyanina, 2018), mycoplasmas (Bricker & Stutz, 2004), harmful entomofauna (Korda et al., 2019), also with unfavorable climatic (synoptic) and soil-hydrological factors (Goberville et al., 2016), this indicates that the pathology of *F. excelsior* is a multifaceted phenomenon in which the processes of an infectious and non-infectious nature are systemically interrelated, which significantly complicates the diagnosis of its root causes.

Now in Ukraine, there is a difficult situation with the phytosanitary state of common ash, which requires an urgent solution (Goychuk, Kulbanska & Shvets, 2020). A characteristic feature, in

this case, is the consistent geographical deterioration of the state of tree stands subordinate to the State Forest Resources Agency of Ukraine, as well as ash trees in forest parks, field protection belts, in plantings of settlements. The visual manifestation of the consequences of pathology is systemically interrelated with the hydrothermal indicators of the current year, the physiological state of trees, and the presence of phytophagous insects.

The general scheme of studies of the pathology of *F. excelsior* included the following stages: reconnaissance and detailed forest pathological examinations according to generally accepted forestry-biometric and phytopathological methods; selection of affected organs, isolation of myco- and microorganisms into a pure culture; checking the pathogenic properties of isolated isolates and their identification; research of antagonistic relationships in the system «bacterium-bacteria», «bacterium-micromycete» as possible factors of induction of demutational processes in the forest biocenosis. Also, the influence of meteorological (synoptic) factors as catalysts of *F. excelsior* pathology and harmful entomofauna was investigated in the context of trophic relationships between insects and phytopathogenic microorganisms and as a vector in the spread of bacteriosis.

Ash tuberculosis is one of the most dangerous diseases of common ash, which in Ukraine has reached epiphytotics, especially on overgrowth origin trees. Under the action of the pathogen, numerous wounds, voids, caverns, rotten areas, etc. are formed in the affected plants, not only impairing the physiological processes of trees and devaluing wood but significantly threatens the formation the seed of this valuable woody plant due to damage to the generative organs (fig.1)



**Fig.1. Typical symptoms ash tuberculosis**

Tuberculosis causes more economic damage than environmental damage. Affected trees of older age groups die off relatively rarely, but as a result of a characteristic pathological process, wood is devalued. Affected trunks are usually retracted into firewood.

The most affected by the causative agent of tuberculosis are sprouting ash trees. Taking into account the biology of the pathogen and the pathogenesis of the disease, ash trees, which at a young

age have at least a single, insignificant damage to the trunks or branches, should be cut down and disposed of, since under the conditions of Ukraine, against the currently existing infectious background, to grow ash trees with high quality wood age ripeness is problematic, and partly impossible.

Anatomical, morphological, cultural and physiological-biochemical studies carried out in the Department of Phytopathogenic Bacteria D.K. Zabolotny Institute of Microbiology and Virology of the National Academy of Sciences of Ukraine made it possible to establish that the microbiota of tuberculous pathology of *F. excelsior* is made up of bacteria of the genera *Pseudomonas*, *Erwinia*, *Xanthomonas*, in particular *Pseudomonas* sp., *P. syringae* pv. *savastanoi*, *P. fluorescens*, *P. syringae*, *P. agglomerans* (synonyms *Enterobacter herbicola*, *E. agglomerans*, *Erwinia herbicola*), *E. horticola*, *Xanthomonas* sp., as well as the spore-bearing bacteria *Bacillus* sp., which accompanied the tuberculous pathology of *F. excelsior* at all its stages.

The most widespread and harmful component of pathogenic microflora is the causative agent of tuberculosis *F. excelsior*, which we identified as *Pseudomonas syringae* pv. *savastanoi*. During artificial infection, we determined that *P. syringae* pv. *savastanoi* showed high pathogenic properties on various organs of *F. excelsior* and indicator plants (*Phaseolus vulgaris*, *Nicotiana tabacum*, *Kalanchoe laciniata*). *F. excelsior* leaves are not sensitive to the pathogen.

For the purpose of prevention and to reduce the general infectious background, systematic monitoring should be carried out in stands with the participation of *Fraxinus excelsior*, to observe the cenotic optimum of ash in the composition of forest stands, to prevent thickening, to remove and dispose of young ground-ash tree affected by *Ps. syringae* pv. *savastanoi*, and create favorable conditions for the growth and development of common ash. The use of biological products based on *Bacillus* sp. and other myco- and microorganisms with existing antagonistic properties to phytopathogens.

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