

УДК 630\*443.3

V. A. Yarmolovich<sup>1</sup>, O. Yu. Baranov<sup>2</sup>, S. V. Panteleev<sup>2</sup>,  
N. G. Dishuk<sup>3</sup>, N. O. Azovskaya<sup>1</sup>

<sup>1</sup>Belarusian State Technological University

<sup>2</sup>Institute of Forest of the National Academy of Sciences of Belarus

<sup>3</sup>Central Botanical Garden of the National Academy of Sciences of Belarus

### RECOMMENDATION FOR THE PROTECTION OF PLANTING MATERIAL IN FOREST NURSERIES FROM THE MOST COMMON DISEASES

46 Belarusian forest nurseries were examined using up-to-date methods of molecular genetic analysis. The study showed that genetic characteristics of phytopathogenic microorganisms detected on seedlings and saplings changed significantly last years. Our research has established that forest nurseries are not only affected by typical phytopathogens, such as fungi of the genera *Fusarium*, *Alternaria* and *Cladosporium*. But also some new species, for instance fungi of the genera *Phoma*, *Epicoccum* and etc. were detected. Based on the study of modern species composition and biology of phytopathogens, the conditions for a local epiphytotic appearance and in the accordance with the requirements of the Ministry of forestry of the Republic of Belarus “Recommendations for preventing of the most common diseases of plant material in forest nurseries” were developed. The document contains the main determinant seedlings and saplings diseases based on visual features, the species composition of pathogens, description of the main symptoms, conditions conducive for the development of plant pathogens, as well as a set of preventive and protective measures. The recommendations for timely identification of plant disease, collection, transportation, temporary storage and transportation of samples for laboratory diagnosis in the case of the presence of atypical symptoms are also shown in this document.

**Key words:** forest nurseries, forest pathology inspection, molecular genetic identification, diseases of seedlings, recommendations, prevention, protection of planting material.

**Introduction.** Global climate change, the introduction of plants, the active movement of plants for planting, the introduction of new technologies for growing seedlings and saplings, and the plasticity of microorganisms, and many other factors lead to the appearance of cases of mass destruction of plants in forest nurseries by pathogens that are not described in classical textbooks on Forest Phytopathology. Currently, cases of destruction of plants by so-called “weak parasites”, often dwelling in the soil or outside it on dead organic matter, but able to parasitize on plants with poorly developed, broken integumentary tissues, weaken immunity, have increased. Therefore, there is need to revise the species composition of plant pathogens that cause diseases of planting material in forest nurseries, studying their biology, and developing of systems of protective measures.

**Main part.** Phytopathological inspection 46 forest nurseries (mostly permanent), located in all six SPFI of the Republic of Belarus, were held by us during 2011–2015, within the SSTEP “Forests of Belarus – productivity, sustainability, efficient use”. Field studies of collecting of samples of infected plants, the selection of pathogens in pure culture were carried out by conventional in forest phytopathology and mycology methods [1]. Identification of the species composition of pathogenic organisms was carried by modern methods of molecular genetic diagnosis [2]. It is currently the

most accurate laboratory methods of identification of pathogens that allow operatively obtain information about qualitative and quantitative content of infectious material in tissues of infected plants.

Survey conducted let to reveal the structure of plant pathogens of planting material of forest woody plants (Figure). The test results showed that cases of destruction of coniferous plants in nurseries by mold and other fungi, belonging to the facultative parasite (*Cladosporium*, *Alternaria*, *Phoma*, *Epicoccum* spp., etc.), which cause partial or complete drying of the plants became more frequent.

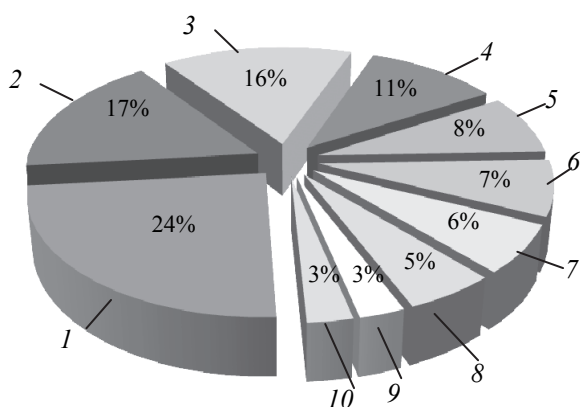
The most frequently found on deciduous trees were powdery leaf mildew, fungus spot, rust. These diseases are easily identified by visual means, and frank symptoms rarely require the use of DNA analysis.

We have developed the document called “Recommendations for the prevention of the most common diseases and protection of planting material in forest nurseries” (here in after – “Recommendations ...”). It is based on the studies of modern structures of pathogenic organisms in forest nurseries, on the assessments of the conditions of growing seedlings and saplings and implemented protective measures, on the study of normative documents applicable in forest protection and reforestation.

“Recommendations ...” include the general and special parts, as well as applications. The general part contains obligatory for documents

of this type structural elements: field of application; regulatory references; terms and definitions; general provisions.

Special part begins with a key to determine the major diseases of planting material. It is a simple step by step instruction for workers of forestry institutions that allow identifying the most common diseases of seedlings and saplings in nurseries on typical symptoms. The end result of the determination by the key is establishing the names of plant diseases and obtaining a specific reference to the description.



The percentage of cases of revealing of pathogens of coniferous planting material in forest nurseries in Belarus (2011–2015):

- 1 – *Cladosporium* spp.; 2 – *Alternaria* spp.;  
 3 – *Phoma* spp.; 4 – *Epicoccum* spp.; 5 – *Fusarium* spp.;  
 6 – *Botrytis* spp.; 7 – *Lophodermium* spp.;  
 8 – *Sclerophoma ptyophila*; 9 – *Rhizoctonia solani*;  
 10 – *Sphaeropsis sapinea*

The description of the most common diseases of planting material, biological features their causing agents and recommended protective measures can be found in “Symptoms of illness seedlings and saplings, protective measures” part. The descriptive part of each specific disease is divided into the following structural units: the name of the disease; affected plants; pathogens; symptoms of the disease and the conditions conducive to its development; security measures. It should be noted that the description of disease symptoms is based, primarily, on our own numerous field and laboratory studies, and some diseases (*Phoma* blight, *Epicoccum* needle necrosis, *Diplodiosis*) were described by us for the first time. For a visual comparison of symptoms photographs of affected plants are provided in one appendix of “Recommendations ...”.

Protective measures of planting material from the most common diseases include a wide range of agro-technical, physical, mechanical, biological, chemical and other measures. Specific measures increasing plant resistance to a particular disease, preventing its development or significantly reduc-

ing losses if a massive infestation of plants has already occurred are provided in this section. In the last two cases on the basis of many years of laboratory and field tests of modern fungicides, biologics, meeting modern standards of the Forest Stewardship Council we registered highly effective disinfectants of seeds, as well as preparations for the treatment of above-ground vegetative parts of coniferous and deciduous woody plants and watering of soil in the outbreaks of infectious lodging in the “State Register of plant protection products (pesticides and fertilizers), approved for use on the territory of the Republic of Belarus”. The list of these fungicides with an indication of the active substance, target species, disease against which each product may be used, its concentration and application rates are listed in the appendix of “Recommendations ...”.

Another section of the structural part of recommendations for the protection of the planting material is the “Forest pathology monitoring and sampling procedure for laboratory diagnosis”. In addition to the TCP 252 2010, it describes some features of early detection of disease outbreaks in nurseries, the order of their registration. It also specifies how to collect samples of the affected material, to carry out temporary storage and transportation to the laboratory (for molecular genetic diagnosis, or other), when the visual definition of the disease on the key causes difficulties due to the absence of typical symptoms.

Due to the importance of preventive measures in the protection of plants against diseases, general health requirements during the laying of forest nurseries and cultivation of planting material are in the separate section “Prevention of disease outbreaks in the process of growing planting material”. This section contains the main problematic aspects of plant cultivation technologies in forest nurseries, the solution of which will allow avoiding local epiphytoses.

Technical principles of using plant protection products in forest nurseries can be found in the section “Application Technology preparations fungicidal action”. The following points are disclosed in detail in this section: preplant seed treatment technology, ground-spraying of plants, watering of soil in outbreaks of infectious lodging, including the procedure for the preparation of working solutions of fungicides, as well as safety precautions when working with toxic chemicals.

**Conclusion.** The prepared “Recommendations ...” is a complex document, its implementation will improve the quality of the measures to prevent the spread of disease and protect planting material in forest nurseries. Currently, the recommendations are being tested in several SFI Gomel and Grodno SFPAs.

### References

1. Padutov V. E., Baranov O. Yu., Voropaev E. M. *Metody molekulyarno-geneticheskogo analiza* [Methods Molecular Genetics analysis]. Minsk, Yunipol Publ., 2007. 176 p.
2. Fedorov N. I. *Lesnaya fitopatologiya. Laboratornyy praktikum* [Forest pathology. Laboratory practice]. Minsk, BGTU Publ., 2004. 448 p.

### Information about the authors

**Yarmolovich Vasilij Aleksandrovich** – PhD (Biology), Assistant Professor, Assistant Professor, the Department of Forest Protection and Wood Science. Belarusian State Technological University (13a, Sverdlova str., 220006, Minsk, Republic of Belarus). E-mail: yarm@belstu.by

**Baranov Oleg Yur'evich** – PhD (Biology), Assistant Professor, Leading Researcher. Institute of Forest of the National Academy of Sciences of Belarus (71, Proletarskaya str., 246001, Gomel, Republic of Belarus). E-mail: betula-belarus@mail.ru

**Pantelev Stanislav Victorovich** – PhD (Biology), Senior Researcher. Institute of Forest of the National Academy of Sciences of Belarus (71, Proletarskaya str., 246001, Gomel, Republic of Belarus). E-mail: pukidesu@gmail.com

**Dishuk Natalia Georgievna** – PhD (Biology), Leading Researcher. Central Botanical Garden of the National Academy of Sciences of Belarus (2B, Surganova str., 220050, Minsk, Republic of Belarus). E-mail: dishukn@rambler.ru

**Azovskaya Natalia Olegovna** – PhD (Agriculture), assistant lecturer, the Department of Occupational Safety. Belarusian State Technological University (13a, Sverdlova str., 220006, Minsk, Republic of Belarus). E-mail: seteck@tut.by

*Received 20.02.2016*