Chapter 18
The Study of Luminescence Spectra of Seeds of Crop Species for Diagnostic Quality

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ABSTRACT

In this chapter, optical luminescent biological objects diagnostics methods and biotissues are considered. According to the previously developed method, excitation and photoluminescence spectra agricultural plants seeds, including cereals, legumes, fodder, technical, and vegetable, were measured. The typical excitation spectrum lies in the range of 355-500 nm and has two maxima: the main one at 424 nm and the side one at 485 nm. The luminescence spectrum lies in the range of 420-650 nm and has a maximum in the region of 500-520 nm. The maximum luminescence is less pronounced than in the excitation spectrum. The measured spectral luminescence characteristics forage plants seeds by scarification. Due to the scarification forage plants seeds spectral characteristics increase. In Galega seeds with multiple scarification, observed qualitative changes in the excitation spectrum was associated with the appearance of a new maximum at a wavelength of 423 nm. Similarly, for clover seeds, the obtained results can be used to create seed diagnostics devices.

INTRODUCTION

Due to the growing demand of the world's population for food, there is a growing need to intensify the production of high-quality agricultural products. One of the directions of such intensive development is the development and implementation of modern high-performance methods and devices for the diagnosis of seed.

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Optical methods and means of diagnostics and control are highly accurate, selective, Express, as well as remote and non-destructive. They have stable parameters of probing radiation, and the received signals can be received by radiation receivers with a wide range of characteristics, amplified and processed with the help of modern computer programs with the issuance of complex results. Other advantages of optical and optoelectronic diagnostic devices are simplicity and safety of their operation, a minimum of subjective factors and the possibility of integration into existing modern agricultural machines and devices.

There are works considering the use of luminescent analysis (Gaevskj, 2002), polarization-reflective and fluorescent spectroscopy (Ovchinnikova et al, 2005), including laser-induced (Ryabova et al, 2006) for the study and diagnosis of biological tissues. To date, methods and installations of optical diagnostics of biological medical facilities have been developed (Monich et al, 1994). Analysis of luminescence spectra is used to determine the protein content, vitamins, starch, the potato tubers landscaping degree, detection of rot and diseases of citrus fruits, onions, potatoes and grapes (Bashilov, 2005; Sventickji et al, 1990; Baek et al, 2013; Li et al, 2016; Leemans et al, 2017; Belzile et al, 2004; Liu et al, 2016; Noh et al, 2006). Optical methods are used to diagnose fruits of fruit trees.

In plant breeding and seed production due to optical density thin ismel received seeds in the near infrared region can be used to diagnose the level of Gib-radnoti with the use of a calibration series, the samples with known level of hybridity.

A common method of in vivo optical diagnostics of biotissues is fluorescent spectroscopy of biotissues. Despite significant achievements in the field of in vivo reflective and fluorescent spectroscopy of biotissues, the possibilities of methods are far from exhausted. The main difficulty facing the development of methods is the limited number of experimentally measured parameters and sufficient statistical data.

The aim of this work is to study the spectral characteristics and parameters of excitation and luminescence of seeds of agricultural plants in order to diagnose their quality. The influence of multiple mechanical scarification on the luminescence of seeds of forage plants was also studied.

SPECTRAL LUMINESCENT CHARACTERISTICS INVESTIGATION OF AGRICULTURAL PLANTS SEEDS

Optical spectral excitation characteristics measurement and luminescence of agricultural crops seeds were carried out on the basis of hardware and software complex, consisting of a multifunctional spectrofluorometer “Fluorate-02-Panorama”, a computer with installed software “PanoramaPro” and an external camera for the investigated samples (“Lumex”, 2018).

Mathematical processing of measurement results was carried out by means of the supplied software or other software products, for which it is provided to export the measurement results in ASCII and MS Excel formats. The method of measurement of excitation and agricultural seeds luminescence spectra developed By M. V. Belyakov is described in more detail in (Belyakov et al, 2016).

To study the luminescence spectra seeds of crops were used: cereals (wheat, rye, triticale, barley, oats, corn, millet), legumes (peas, soybeans, white beans), herbaceous (clover, buckwheat, amaranth, rape, Vika, sunflower, lentils, Galega Oriental, flax), vegetables (pumpkin, cucumber, radish, tomatoes, zucchini, cayenne).