


Chapter 11

How to Manage the Effectiveness of Presowing Treatment of Seeds

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ABSTRACT

Variants of seed response to external disturbances were studied to determine the principles that should be followed during pre-sowing treatment. The approach that involves analysis of seeds' adaptive response has been applied. The basic organizational rules have been specified for external disturbance application to seeds. The use of informational method for studying the biological response of seeds on external actions made it possible to find the rules that have to be followed when pre-sowing treatment is performed with the use of electrophysical excitation. The essence of these rules is that the following sequence of operations shall be carried out in the process of pre-sowing treatment: to define the lowest energy level of external disturbance corresponding to the seed's sensitivity threshold, to organize cyclic action of external factors on seeds, to vary the amplitude of external factor within cycles, to vary the mode of external disturbance. The field experiments were carried out for several years, during which the pre-sowing treatment of seeds was determined.

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INTRODUCTION

Presowing treatment of seeds belongs to important technological operations designed to improve quality of seeds providing pest control and enhancement of their sowing qualities. At the present stage of development of these technologies, methods of seeds exposure to various external electrophysical factors are in wide use making it possible to improve yields of agricultural crops at the expense of relatively low energy consumption for processing. This adds an incentive for further development of research in this field. Nevertheless, processing lines using these methods are not in sufficiently wide actual practical use, today. There exist a number of reasons for such situation of which the principal one is that seed is a biological object with all its specific reactions on various factors of external excitation inherent to each particular crop. Let us consider certain elements of effects that electrophysical external factors produce on properties of seeds in order to answer the questions that provide a subject of agricultural technologists' concern.

BIOLOGICAL ISSUES RELATED TO SOWING QUALITY OF SEEDS EXPOSED TO VARIOUS EXTERNAL FACTORS

Reviews of seeds presowing treatment methods show that there exists a general response pattern of living organisms, particularly that of seed, on external excitation. This response may appear in both retaining the initial status of seed (biological resistance) and self-adapting to new conditions.

Reactions of plant cells on various external factors, particularly, on temperature change, appear to be similar to those of other organisms (animals and humans) (Rubin and Riznichenko, 2014; Aleksandrov and Kislyuk, 1994; Gamburg, Borovskii, & Voinikov, 2017; Shapovalenko, Dorovskih, Korshunova, Shtarberg, Slastin, & Nevmyvako, 2011). Therefore, further on, we will involve data related not only to plants but also to other biological objects, in the course of our study.

In a number of works (Garkavil, 2015; Sel'eGans 1979) any external factor making its effect on plants is considered as stress that results in adaptation and development of immunity to it. In the course of immunity development in plants, response of specific types is a step-wise process. First, non-specific reactions on stress occur such as change in membrane permeability, hyperchromatism, change of pH value, drop of cell membrane potential leading to the change of cytoplasm structure. Due to the effect of these short-term responses intermediate reactions take place (acute phase proteins synthesis, inhibition of vegetation and photosynthesis). In Table 1 provided below, the sequence of non-specific stress reactions transformation into specific immunity response is presented.

Multi-year experience of studies in the field of life evolution shows that there exists a rather limited range of standard, uniform, reactions on an extensive variety of external excitation factors. Thus, all kinds of external factors (microwave fields, laser radiation, heating and so on) induce nearly similar stress in seeds. All reactions differ depending mainly on the penetration depth of particular external excitation (differently affecting different structural elements of seed), excitation intensity and time of exposure.

Stress is defined as response on a strong disturbance though there is no clear classification of disturbance sources, in their strength of effect. Results of fundamental studies of various kinds of stress applied to living organisms have been reviewed by Selye (Sel'eGans, 1979; Sel'eGans, 1960; Sel'eGans,

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