MODEL OF ECOLOGICAL FUNCTIONS OF GROWTH AND DEVELOPMENT IN POTATO

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Abstract

On the basis of the algorithm of the organogenesis cycle and the meteorological data available for forming the base of meteorological parameters during each phenophase, i.e. the defined algorithmic step, we provided conditions for the development of the model of ecological functions of the organogenesis cycle in the potato. The methodological model represents a computer program which stores meteorological data daily and calculates the trends immediately. The average accumulation of the analyzed parameters was also calculated on the basis of these trends.
The model developed in this manner, would, on the basis of the average values of several-year- functions and recorded variations of ecological parameters, within each defined stage, i.e. the defined algorithmic step, increase its preciseness in time concerning the estimation of the moment of their onset and of the expected degree of productivity from the ecological or agrotechnical aspect.

1. Introduction

The development of the highly intensive plant production technology, in its basis, means the definition of the methods and procedures used for conducting the process of growth and development of these plants.

The basis for this approach is the integral study of all the phenophases as well as organ and tissue differentiation processes in certain ecological conditions. In other words, it means the definition of the organogenesis cycle on the algorithmic basis and the development of the model of ecological functions of the organogenesis cycle (Mićić, *et al.*, 1996).

In this way the application of each agrotechnical procedure can be taken as a treatment of the current differentiation phase or its effect on the plant development processes. Through a precise locating of some treatment application on the current course of the differentiation phase and, afterwards, through a clear determination of its effects on the formation and realization of the yield potentials, i.e. the organogenesis cycle productivity, possibilities are created for defining the complete cycle as a mathematical model aimed at the simulation of the organogenesis process.

In this way, such a cycle is determined also as a biological basis for the definition of an expert system for creating and applying the highly intensive technology in growing agricultural crops.

2. Material and methods

This model, in its basis, represents the software which stores meteorological data at 7, 14, 21 o'clock every day and calculates, immediately, the trends such as:

$$y = a + bx_i + cx_i^2 + dx_i^3,$$

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On the basis of the trends it calculates the average accumulation of the analyzed parameters:

$$\sum t^{\circ}C = \int_{t_1}^{t_2} f(x)dx - A(t_1 - t_2)$$

- t_1 - the moment of $f(x)$ trend of the average daily temperature rising above the limiting constant temperature - the lower temperature limit of the phenophase (y = t° C);
- t_2 - the moment of the onset of the flowering - inflorescence;
- A - the constant temperature - the lower temperature limit of the phenophase (t = 8°C)

The investigation into the efficacy and preciseness of the defined model for the analysis of ecological parameters regarding the organogenesis in the potato was carried out by providing the computer with the data on the average daily temperatures, both absolute maximal and minimal temperatures for the period 1991 - 1995, together with the data on the time of planting, the emergence and flowering stages of the Desire potato variety during the same period. The data used for the analysis of the model were obtained from the Potato Research Center, Guča, The experimental station Kaona.

3. Results and discussion

The data about the time of the phenophases occurrence *in situ* show that the planting of the potato in the investigated period was done within the time range of 25 days. The time range of the emergence stage was 27 days and that of the flowering stage was 25 days.

For analysis, the experimental data were stored into the computer databases for each year respectively. The results of the analysis are presented in the figures 1 - 5. Through a comparative analysis of the graphs, the following conclusions were procured:

- The model represented a clear regularity in the interaction of the average daily temperatures and the investigated phenophases in the years 1991, 1992 , 1994 and 1995. However, it must be said that, in the course of 1993, this model showed distinguishing aberrations in the potato development.
- In the years 1991, 1992, 1994 and 1995 the potato was planted at a time when trends of the average daily temperatures reached or rose above the average daily temperature lower limit of 8°C. However, in 1993, the planting was done at a time when the average daily temperatures rose above 12°C, which caused a disturbance in the potato development during this period.
- In the course of 1991, 1992, 1994 and 1995 the potato emergence stage corresponded to the trends of the average daily temperatures reaching 12°C.
- In the years when the potato was planted at the average temperature of 8°C and the emergence stage was on the average daily temperature of 12°C. The onset of the flowering - inflorescence phase was, approximately, 36 days after the emergence stage, i.e. when the average accumulation of the daily mean temperatures above 12°C was 91.58°C. The average aberration in the estimation of the moment of the flowering phase onset was ± 0.86 days (coefficient of variation 4.86%), when this model was applied. The average aberration of the temperature amount was ± 4.21°C (coefficient of variation 9.18%).

This clearly showed the preciseness of this model in estimating the occurrence of the investigated phenophases.

Through analyzing the dynamics of the phenophases in the potato development in 1993, when the aberration occurred due to the late planting (average daily temperature