Acta Biotheoretica **39**: 253–270, 1991.

INFOGENESE EN BIOLOGIE VEGETALE

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ABSTRACT

The construction of theoretical models in biology, situated at the cross-roads of biology, mathematics and computer science, often leads to a tool as final product. Its genesis can be named 'Infogenesis'. The procedure of the resolution of theoretical problems is analyzed on examples of practical purposes taken from plant biology.

The first example deals with mineral plant nutrition, explaining a way to go from theoretical ionic balances to the experimental realization of nutritional solutions with macro-element components.

The balanced concentrations of ions are expressed in terms of concentrations of electrical charges (milli-equivalent per litre). The neutral combination of anions and cations results from salts, acids or bases introduced in water. To achieve this combination, a table lines up concentrations in cations in the last column and concentrations of anions in the bottom line, their sums being equal. The obtained quantities of salts appear at the intersections of lines and columns. An expected ionic equilibrium is equivalent to the filling up of the table considered as a mathematical matrix. The algorithm constructing the table permits e.g. to use fewer salts or some salts preferentially. The procedure minimizing the values of elements corresponding to non-desired salts is presented. A prior order, which is the reverse to the use of preferential anion/cation pairs, is required for the successive treatments of the elements.

An algorithm of "successive splittings" respects the weights of sums in lines and columns. It mainly looks for the maximal quantity that can be taken from a chosen box in the table *i.e.* from the salts, and carries out its splitting. The repetition of this operation takes into account the impossibility to add a positive value to a minimized term. Therefore, during the operation, some lines and columns have to be "frozen", *i.e.* their values are considered as unchangeable. The number of rewritings of the table by the splitting method depends on the order of treatment of the elements, their number and the weight of lines and columns.

The method gives a global approach of the mineral nutrition in terms of ion concentrations. An initial chemical definition of the problem leads to the constructions of algorithm on the basis of the successive splitting method. It is resolved mathematically and computerized via a dynamic arrangement of elements in the table. The determination of salts formulas from the known ionic concentrations is the practical objective and the filling up of the table is the computerized means. Initial data is the sums in lines and columns. The resolution is accomplished by the weighted redistribution of the values taken from each box in the table. The realization is done within a loop of calculations, rewriting the terms of the grid according to a predefined preferential order.

In a second example, a procedure opening the way to the construction of the form for a plant from empirical data is discussed. The study of the vegetative development of woody ornamental plants is necessary to manage the production of commercial varieties during the plants breeding process. The aspect of the plant, regularly recorded, can be reconstructed by image synthesis. Additionally, knowledge about the underlying biological mechanisms becomes accessible if the synthesis images are ordered by the algorithmic formulation of hypotheses on the development.