

ON THE SOME PROBLEMS OF INFORMATION SYSTEM OF THE OPTIMIZATION IN AGRICULTURE

Svetlana Eyubova¹, Adalat Pashayev², Elkhan Sabziev³, Goshgar Mammadov⁴

¹Institute of Soil Science and Agrochemistry of ANAS, Baku, Azerbaijan, *svetlana@kiber.az*

²Kiber Ltd Company, Baku, Azerbaijan, *adalat@kiber.az*

³Cybernetics Institute of ANAS, Baku, Azerbaijan, *elkhan@kiber.az*

⁴Institute of Soil Science and Agrochemistry of ANAS, Baku, Azerbaijan, *info@kiber.az*

Introduction. The development of the information and expert systems for information maintenance and management of technological processes in agriculture is one of major directions of information of agricultural manufactures. The information basis of such system includes dynamic models of the production process of the basic agricultural cultures and sorts.

In [4] the basic principles of development of expert and I&R systems for management of production processes in agriculture were offered. This system will allow the agriculturists and farmers to solve rating and prediction problems of the facilities on the basis of the soil and climatic characteristics of region, and also features of concrete sorts of growing culture. It will enable, on the one hand to determine the optimum accommodation of cultures, structure crop rotation, on the other hand to optimize receptions, terms and ways of processing of ground, entering of fertilizers and actions on plants protection.

The basic calculating tasks are account of possible and potential productivity on photosynthesis active radiation (PAR), prediction of productivity on moisture of crops, and also task of calculation of norms of fertilizers at joint entering of mineral and organic fertilizers.

The aim of the present article is the calculation of norms of the basic fertilizers - nitrogen, phosphorus and potassium (NPK) at joint entering of mineral and organic fertilizers. The calculations will base on results of fundamental and applied researches domestic [1, 5] and foreign scientific [2, 3] in the field agrochemistry of balance researches.

Main part. For the offered expert-information system the initial information basis is creation of the information database under the characteristic of a facilities, requirements of the basic agricultural plants to the predecessors, soil and agro climatic conditions, on various technological operations of cultivation of the basic plants and their cost. On the basis of this information it is made up I&R and information calculating blocks. Then they subdivided on a number of subtasks. The general diagram of the solving of the problem on calculating of norms of fertilizers is resulted below (scheme 1). Let's explain some items of this scheme.

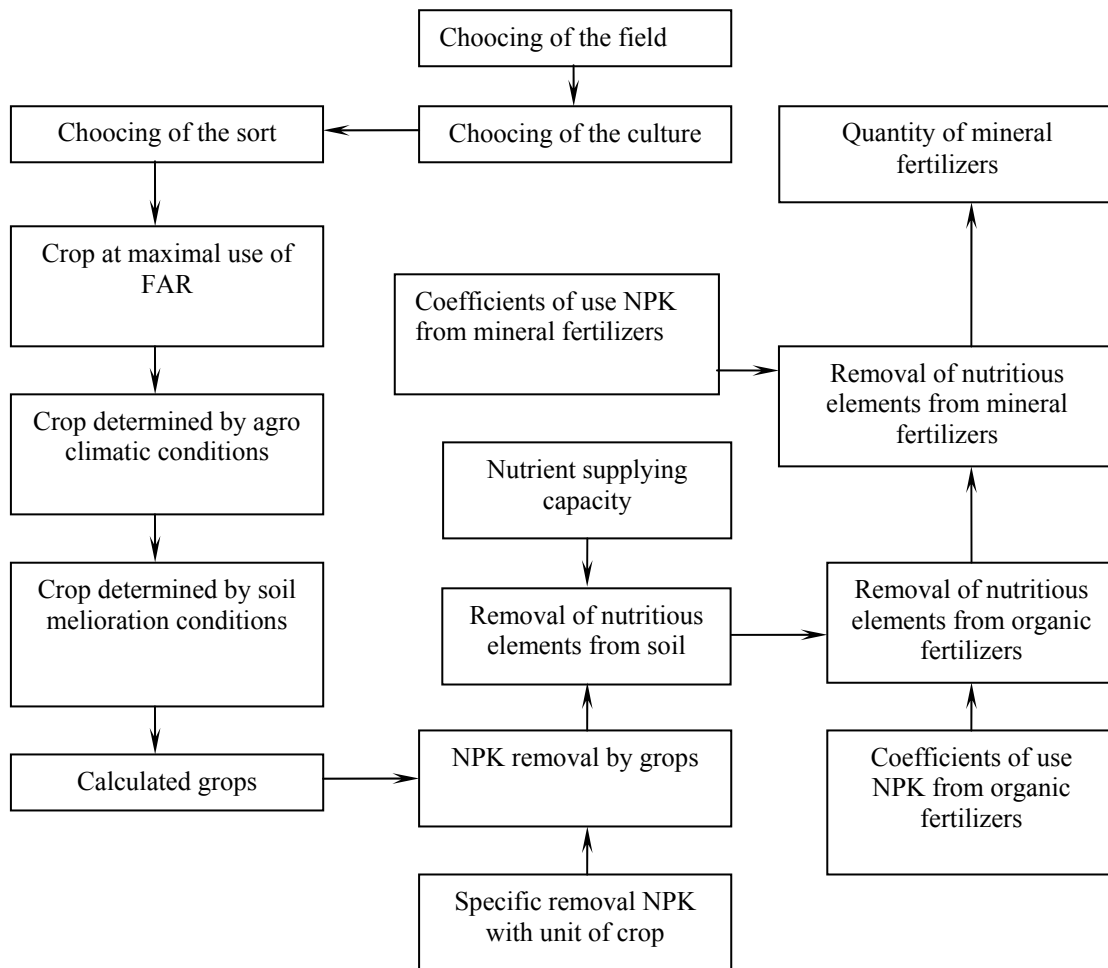
The organic substance of plants is making basically at the photosynthesis process. As a result of this the calculating of potential efficiency of cultivated plants is spent on greatest possible use of the PAR. The calculating of a potential crop depending on arrival photosynthesis of active radiation is spending after choosing of a field, optimum culture and its grade. For this purpose the below-mentioned formula is used [2]:

$$Y = \frac{R \cdot K}{E},$$

where R is the quantity of PAR for per 1 hectare tillage for the considered period vegetation of plants, (billion kilojoules/hectare), K is the coefficient of ratio by plants coming PAR on formation of bio-weight (%), $E = 400000$ kilojoules is the average quantity of the energy, accumulated in 1 centner of dry substance of plants.

The receipt of PAR on the given surface depends on the solar light angle, from an inclination of a surface and orientation on the cardinal points. So, for example, the southern

mountainside at an identical steepness receives more PAR than northern mountainside. Therefore these factors further will be taken into account by entering corresponding corrections.



Scheme 1. The block -scheme of the solving of calculation of norms of fertilizers

The really possible productivity is determined by resources of heat and biological features of plants. For this purpose one uses the following formula [2]:

$$Y_t = \frac{Y \cdot (t - b)}{t_{opt} - b}$$

Here Y_t is the potential productivity provided with resources of heat (centner/ha), t is the daily average temperature of air for the vegetation period (C^0), t_{opt} is the optimum daily average temperature for the given culture (C^0), b is the minimal temperature for growth of culture (C^0).

The precomputation of possible productivity of the chosen culture on the all limiting factors will allow more precisely to set a planned crop. Thus the processes of interaction of fertilizers with ground and plant through correction factors are taken into account. It should be taken into account also previous culture, fertility of ground, its mechanical structure, erosion.

With use of the given dependences it is possible to vary doses of entering of mineral and organic fertilizers, and also various variants of simple and complex fertilizers.

For definition of norms of fertilizers on a crop, we shall apply the formula [3]

$$D = \frac{U_p \cdot B - (P \cdot K_p + D_{\text{orq}} \cdot C_{\text{orq}} \cdot K_{\text{orq}} + D_{\text{os}} \cdot K_{\text{os}})}{K_u},$$

where U_p is planned crop, B is the removal of nutrition elements by the given crop (kg / ha), P is the quantity of an accessible nutritious element in soil (kg / ha), K_p is the coefficient of using of element from soil (%), D_{orq} is the quantity of applying organic fertilizer (t/ha), C_{orq} is the quantity of nutritious elements in organic fertilizer (kg/t), K_{orq} is the coefficient of using of nutritious elements from organic fertilizer, D_{os} is the residual quantity of nutrition elements of previous fertilizers (kg/ha), K_{os} is the coefficient of using of nutritious substances with residual effect (%), K_u is the coefficient of using of nutritious from mineral fertilizers (%).

Calculating the quantity of nutritious applying by each kind of fertilizer it is possible to predict productivity of given soil, provided with fertility.

As it is shown from the given formulas, for definition of fertilizers applying norms for the planned crop, it is necessary to know values of a number of coefficients. In practice these coefficients are as a result of long-term experiments and depend on conditions of concrete soil and culture. By the reason of a concrete definition of conditions in which those or others coefficients are concretized are conditioned by the productivity besides nutritious elements depends as well on the PAR, on the plant provision moisture and on the grades of plants.

There is a task - how to restore the coefficients participating in the formulas of optimum nutritious elements, determining quantity brought in by fertilizers on the basis of the information on natural conditions, grades of plants, modes of cultivation received crop?

For a choice of a method of the decision of the considered task should be taken into account one more factor, namely that the value of coefficients vary in a beforehand known interval.

For the decision of the given task was offered to applied neural network. Let's describe in general the structure of offered neural network.

In the limits of a rational cultivation mode of plant, the coefficients at one or another determining parameters are considered as constant. These coefficients, in generally, implicitly depend on those parameters, which at an establishment of the appropriate laws were accepted as constant background parameters. Implicitly of considered independence, often is a source of difficulties for the decision of many tasks of norms definition and cultivation modes.

Is offered to replace the set of above said dependences by obvious dependence with formula of required parameters from determining parameters as

$$D = \sum_n \beta_n \prod_m x_m^{\alpha_{m,n}}, \quad (1)$$

where β_n are some coefficients, x_m are determining parameters, $\alpha_{m,n}$ are degree of influence of entry parameter m at coefficient n .

In terms of the theory of neural network, the formula (1) is a nonlinear single-layer perceptron.

Let's notice that, on a basis of the experimentally established empirical laws the some part of these numbers $\alpha_{m,n}$ or all together can be known. Depending on it can be developed the algorithm of definition of coefficients β_n and unknown degrees $\alpha_{m,n}$. As one of criteria taken into account at development of algorithm of definition of coefficients of perceptron, there should be an exact enough approximation of results represented by the known empirical formulas.

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