OPTIMIZATION OF MAIZE TECHNLOGY USING PRODUCTION FUNCTION METHOD

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Abstract

An optimization model for yield and fertilizer efficiency was established by many years and sites experimentation of N, P and K fertilizer combination for maize production on many soils. Improving the technical and economic results at the level of any crops represents an objective necessity and can be achieved, in good conditions, through a continuous process of optimization and re-optimization of the main economic activities. We have committed to present a few aspects connected to the optimization of sour cherry tree culture technology in this paper, using different kind of production factors. The research subject is necessary in order to find out the problems raised by the culture of the sour cherry tree and their solving using production functions method. The production functions show the dependency of the acquired crops in relation to the level of use of different production factors. When the farm possesses sufficient quantities of paper fertilizers, the problem which rises is the establishment of the doses corresponding to the maximum technical and the economic optimum. This can be realized by differentiating the doses of fertilizers, the combination reports, as well as the kind and type of the fertilizer. It is very important to mention the methods and calculation techniques when making on optimization study, because it gives the possibility to estimate the level in which a studied phenomenon is comprised and analysed.

Key words: factors, production, optimization, technology

The optimization process of different fertilizer combinations, of natural ones, as well chemical, can be realized with the help of production functions. The production functions materialize the dependence of the productions obtained compared to the level of different production resources utilization. The production functions can be used only if this dependence is continuous. The main mathematical method through which the analysis studies are detailed, foreseeing on optimization, and the real form is replaced by its model, is the mathematical-economic shaping which offers, for the studied matter, a mathematical and economic optimum.

In the structure optimization different kind of crop types, the most used methods are: the method of multiple alternatives, the Planning method, the geometrical method, the lineal programming method which is the most complex because it allows the choice of the most efficient one from all solutions and alternatives, being given the natural and economic conditions.

MATERIAL AND METHOD

The optimization of production technology using production functions method. As a method of fertilizers use optimization, is utilized the lineal programming as a distinct process or as a part of optimizing, the resources used at soar cherry tree technology, and the economic-mathematical model built starts from the most simple form and gets to one of the most complex forms.

The methodology of fertilizers use economic optimization is based on covering more stages and allows to be taken into account the influence of all factors and the interaction between them, the solutions obtained comprising elements which characterize the farm on the whole, as well as elements which characterize its component parts.

RESULTS AND DISCUSSIONS

The production function is the mathematical expression established between the result of production and the quantity of resources consumed; it appears as:

$y = f(x_1, x_2, x_3 \dots x_n)$ where y represents the production obtained (dependent varying terms) and x_1, the resources consumed (independent varying terms). Compared to the mathematical function where to every element corresponds a certain well established value, in agriculture appears the situation that for each unity of earmarked factor correspond more values (effects) in time and space.

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This is owed to the fact that between the relation cause-effect comes the fruit tree, as a living organism meant to be influenced by the causing factors as well as by other factor which cannot be entirely controlled. The increase of production takes place up to a certain moment after which appears the decrease of the varying productivity factor. Each quantity of supplementary added means a decreasing quantity of produce on the total production per hectare.

The increase of fertilizers quantities productivity appears only when the curve is increasing and new quantities are necessary.

The relation between the quantity of chemical fertilizers use and the production obtained per hectares can be represented as a function:

y = f(x), where

în care:

x = value of independent varying term;

y = value of dependent varying term.

This function is also called monofactorial function which expresses the dependence of production results compared to a single factor of production. The dependence of the production results near to a certain factor of production can have a lineal form if it's expressed as:

y (x) = a + bx, where:

a = value of function for x = 0 or the point where the y axis crosses the straight line;

b = the tangent of the angle formed by the straight line and the x axis.

In order to establish the allotment of chemical and organic fertilizers doses which ensure the maximum profit achievement (economic optimum), the function of production must be transformed from physical expression to value expression.

Y (Rol/ha) = y (q/ha) x Py (Rol/q) and equalize the marginal profit expressed as value with the costs of fertilizers.

In order to better understand the calculation method it is necessary to know the possibilities of replacing the fertilizers, in what proportion fertilizers could be combined in order to minimize the costs of production and what quantity of each fertilizer should be used for different species. The rational replacement starts from establishing the marginal rate of substitution and the optimum combination of fertilizers is based on minimization of costs of production in order to obtain the same production volume.

The conditions of optimum combination impose that the marginal rate of substitution to be equal to the reverse report of costs.

Table 1

Calculation of the necessary elements to determine the coefficients

Manure - Doses -	Chemical fertilizers - media productions of maize (kg / ha)			
	0	2	4	6
0	0	2,1	4,2	6,3
0	4,8	6,1	7,0	7,8
2	6,1	6,8	7,9	8,1
8,5	7,2	8,0	8,6	8,5
8,4	7,6	8,2	8,3	8,4
8	7,8	8,0	8,1	7,5
10	7,1	7,9	6,2	6,0

Quantities of manure and chemical doses are expressed. A dose of manure is 5 tons of manure per hectare, and a dose of fertilizer is 125 kg active substance per hectare, consisting of 25 kg to N, 50 kg S.A. P and 50 kg S.A. K. maize production in tonnes per hectare. To calculate expected yields depending on the doses of fertilizers were calculated coefficient values a11 = 0.663047, a12 = 0.068058, a21 = 0.47125, a22 = -0.04375 and $a_0 = \frac{y - aixi}{n}$ a_0 = 5,713437.

In order to obtain maximum yields, using optimal doses of chemical fertilizers and manure are necessary following calculations:

A. Calculations to determine maximum physical production:

B. $x_1 = \frac{-0.663047}{2(-0.068058)} = 4{,}871191 \sim 4.88$

$$x_2 = \frac{-0{,}47125}{2(-0.04375)} = 5{,}385714 \sim 5.39$$

In terms of using natural and chemical fertilizers for maize, it appears that the same level of production can be achieved by combining different amounts of the two fertilizers. Curves on which all combinations of fertilizers that ensure the same level of production or izocuant of izoproduction called.

The maximum allocation x^1 factor to determine the maximum yield is 4.88 doses, and the dose factor x^2 is 5.39.

Allocating manure doses of 4.88, ie 24.4 tons of manure per hectare production can be obtained as follows:

$yx_1 = a_0 + a_{11} \text{ x } 1 + a_{12} \text{ x } 1^2$

yx_1 = 5,713437 + (0,663047*4,88) + (-0.068058*4,88)= 8,616983 ~ 8.62

yx_1 = 8.62 t/ha

To allocate chemical fertilizers in amount of 5.39, ie 673.75 kg to per hectare, one can obtain the following output::

$y\ x\ 2 = a_0 + a_{21}\ x\ 2 + a_{22}\ x\ 2^2$

$y\ x\ 2 = 5{,}713437 + 0.47125 * 5{,}39 + (-0{,}04375 * 5{,}39^2) = 6{,}362$

$y\ x\ 2 = 6{,}98$ t/ha

Each of the factors taken separately to obtain maximum yields of 8.62 and 6.98 respectively t If you use more of factor x1 or x2, production will decrease. If the maximum amounts of resource are introduced x1 and x2 in the basic equation, one can determine the final maximum yield that can be achieved by the use of two factors:

$y_{Max} = a_0 + a_{11}\ x\ 1 + a_{12}\ x\ 1^2 + a_{21}\ x\ 2 + a_{22}\ x\ 2^2$

$y_M = 5{,}713437 + 0{,}663047 * 4.88 + (0.068058*4.88^2) + (0{,}047125*5.39) + (-0.04375 * 5.39^2)$

$y_{Max} = 9.55$ t/ha

C. Establish maximum economic production

In order to establish optimum economic production is necessary to know the prices of resources and output obtained.

Thus, prices were considered, the following average values: for manure 10 Rol / ton, for fertilizers, differentiated by content active substance ;N-1.0 Rol; P-1,1 Rol; K –1,1 Rol. maize production 9000 Rol/kg.

P x 1 = 10 Rol/dose; P x 2 = 11 Rol/dose; P_y = 360 Rol/tonă.

$$x_1 = \frac{\frac{P.1}{Py} - a_{11}}{2.a_{12}} = \frac{\frac{10}{360} - 0{,}663047}{2.(-0.068058)} = 4{,}769 \sim 4.77 \text{ doses}$$

$$x_2 = \frac{\frac{P.2}{Py}}{2.a_{22}} = \frac{\frac{11}{360} - 0.47125}{2.(-0.04375)} = 4{,}338 \sim 4.34 \text{ doses}$$

The maximum allocation x1 factor to achieve maximum economic production doses of 4.77 and 4.34 is the factor x2 doses.

4.77 allocating doses of manure manure ie 23.85 t per hectare can be achieved optimum production following:

$y\ x\ 1 = a_0 + a_{11}\ x\ 1 + a_{12}\ x\ 1^2$

$y\ x\ 1 = (5{,}713437 + 0{,}663047*4{,}77) + (-0{,}0680158 *4{,}77^2) = 8{,}55$ t/ha

4.34 allocating fertilizer doses, ie 542 kg s.a./ ha, one can obtain the following optimal production:

$y\ x\ 2 = a_0 + a_{21}\ x\ 2 + a_{22}\ x\ 2^2$

$y\ x\ 2 = 5{,}713437 + 0.47125*4{,}34 + (-0{,}04375*4{,}34^2) = 6{,}93$ t/ha

With each factor separately can get a production of 8.55 t / ha and 6.93 / ha. If you use more or less of one of the factors, production will decrease. Resource allocation after the peak is not justified from any point of view, because costs and increase agricultural production begins to decrease at a rate proportional to the increase in resource allocation.

Economic optimum production that can be obtained by using both factors is:

$Y_M = a_0 + a_{11}\ x\ 1 + a_{12}\ x\ 1^2 + a_{21}\ x\ 2 + a_{22}\ x\ 2^2$

$Y_M = 5{,}713437 + 0{,}663047*4{,}77 + (0{,}068058 * 4{,}17^2) + 0{,}47125*4{,}34 + (-0{,}04375 * 4{,}34^2) =$ 11,28 t/ha

Optimal maximum economic production is natural lower maximum yield 1.73 t / ha.

CONCLUSIONS

The optimization process of different combinations of fertilizers use, of natural ones as well as chemical, can be realized through the production functions. The production functions materialize the dependence of obtained productions near the level of different production resources use. Analysing the influence of fertilizers quantities on the variation of total progress of total production it can be noticed that in the first part of the curve, the production progress records slow increasing rate (between 0-40 kg s.a) so that these progress to suddenly increase (between 40-80 kg s.a) up to a point (2.7 tonnes/ha), point when the production progress reaches a maximum level. Any supplementary factor allotment determines a constant decrease of production progress.

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