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**STUDY OF THE PROCESS OF LOADING AND LEVELING A HEAP OF ALFALFA
SEEDS ONTO A DRYER CONVEYOR**

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Abstract: This article presents in detail the results of a study conducted to determine the optimal combination of factors selected to determine the minimum coefficient of unevenness of loading and leveling of quail seed mixtures in conveyor dryers during the loading process into the dryer. In addition, the expressions for determining the regression coefficient, calculating the Fisher and Student tests, the results of statistical evaluation of the regression coefficient (ν_i), and the results of comparing the absolute value of the regression coefficient and their confidence intervals ($\Delta\nu_i$) are presented.

Key words: unevenness, magnitude, leveling, pile, dryer, factor, screening experiment, planning, regression coefficient, criteria, optimal value, interval calibration.

Introduction: The most important thing when drying the seed heap of forage crops in a conveyor dryer is the uniformity of the material leveling over the entire area of the conveyor, since the heap is distributed in a loosened layer of uniform density and thickness. The creation of such a layer increases the efficiency of drying, reduces drying time, fuel consumption, energy intensity of the process and increases the productivity of the dryer.

The most important thing when drying the seed heap of forage crops in a conveyor dryer is the uniformity of the material leveling over the entire area of the conveyor, since the heap is distributed in a loosened layer of uniform density and thickness. The creation of such a layer increases the efficiency of drying, reduces drying time, fuel consumption, energy intensity of the process and increases the productivity of the dryer. Since the energy costs are low when using a finger working element to level the pile, the unevenness of the material leveling was chosen as the optimization parameter, which largely determines the value of the economic efficiency indicator of the proposed loader.

Materials and methods: A comprehensive study of the technological process of the loader involves taking into account all factors that affect the course and final results of the process under study. The main course and final results of the process under study. The main requirements for the set of factors under study are that they must be controlled and manageable. After conducting a screening experiment and selecting the most significant factors to bring them closer to the area of the optimal combination and finding the best conditions for the

following studies, we used the method of steep ascent along the response surface, based on movement from a certain point on the surface in the direction of the optimum [1, 2, 3].

To find the optimal combination of the selected factors with a minimum value of the unevenness of the heap leveling on the conveyor of the dryer, an experiment was conducted, including 8 experiments, constituting a semi-replica of the full factorial experiment of type 23, and a program of steep ascent along the response surface was also carried out. The experiment was conducted in triplicate in a randomized order. The planning matrix for such an experiment was constructed using a well-known method [2,3].

Results and discussions. Based on the results of the experiment, regression coefficients were calculated and statistically assessed based on the dependence [3].

$$\theta_o = \frac{\sum_{u=1}^N \bar{Y}_u}{N}; \quad \theta_i = \frac{\sum_{u=1}^N x_{iu} \bar{Y}_u}{N}; \quad \theta_{ij} = \frac{\sum_{u=1}^N x_{iu} x_{ju} \bar{Y}_u}{N}$$

$$S_y^2 = \frac{\sum_{u=1}^N \sum_{i=1}^K (Y_{iu} - \bar{Y}_u)^2}{N(m-1)}; \quad S_{ei} = \sqrt{\frac{S_y^2}{N}}; \quad \pm \Delta \theta_i = \pm t S_{ei}$$

where \bar{Y}_u - average value of the optimization parameter in the experiment;

N - number of experiments (number of rows in the experiment matrix);

x_{iu}, x_{ju} - values of factors in the i -th experiment;

m - number of repetitions of one experiment (one row of the plan matrix);

Y_{iu} - values of the optimization criterion in parallel experiments (in the i th line);

S_{ei} - squared error of the regression coefficient;

t - tabular value t - criterion for the number of mean freedom,

with which it was determined S_y^2 ;

S_y^2 - variance characterizing the errors of experiments in the design matrix.

$$\theta_o = 12,54; \quad \theta_4 = 0,84; \quad \theta_5 = +1,52; \quad \theta_8 = +0,82; \quad \theta_{45} = +1,50;$$

$$\theta_{48} = -0,38; \quad \theta_{58} = +0,18; \quad S_y^2 = 0,6365; \quad S_{LF} = 0,957;$$

$$S_{ei} = 0,2827; \quad \Delta \theta_i = \pm 2,12; \quad 0,2817 = 0,5995.$$

After determining the regression coefficients, their significance was checked. The data for calculating the significance of the regression coefficients were used from the table, which presents an algorithm for calculating the adequacy of representing the experimental results by a first-degree polynomial.

Comparing the absolute values of the regression coefficients (θ_i) with the absolute value of their confidence interval ($\Delta \theta_i$), we come to the conclusion that not only linear effects, but also their paired interactions have a significant impact on the optimization criterion..

To check the adequacy of the presented experimental results, it is necessary to determine the calculated value of the Fisher criterion using a first-degree polynomial and compare it with the table value. The calculated value of the Fisher criterion is determined using the formula [1].

$$F_p = \frac{S_{LF}^2}{S_y^2},$$

where S_{LF} - variance of inadequacy of a mathematical model;

F_p - Fisher's exact test.

S_{LF} was determined by the formula

$$S_{LF} = \frac{\sum_{u=1}^N \bar{Y}_u - Y_u^2}{N - (K + 1)},$$

where, Y - theoretical value of the optimization parameter in the i -th experiment;

K - number of factors.

The tabular value of the F-criterion, equal to 5.0, was selected from tables [1] for the number of degrees of freedom $f_1 = N - m - 1 = 4$ and the number of degrees of freedom of the denominator

$$f_2 = N(K - 1) = 16$$

For convenience, all calculations for assessing adequacy are summarized in Appendix 12, compiled taking into account the recommendations of [1]. Using the data from this appendix, it is easy to establish that $S_{LF} = 0,957$, then $F_p = 1,504$.

Table value of Fisher's criterion for 5% significance level $F_{0,05} = 3,0$ exceeds the optimal value of this criterion, therefore the hypothesis about the adequacy of the linear model could be accepted. However, for such a decision it is necessary to check the second criterion – the null hypothesis [1,2,8]. For this purpose, the 9th and 10th experiments were additionally set up in the center of the experiment. The results of calculating the average value of the optimization criterion in these two experiments turned out to be equal $Y_0 = 12,51$. The null hypothesis is accepted if the difference $\epsilon_o - \bar{Y}_o$ does not exceed the experimental error [1]. The variance of the experimental error is equal to $S_y^2 = 0,6365$. The significance of this difference is tested using the Student's t-test.) [1].

$$t_{pacu} = \frac{(\epsilon_o - Y_o) \sqrt{N}}{\sqrt{S_y^2}} = 0,106$$

where Y_o - average value of the optimization criterion for the experiments in the center of the experiment.

The tabular value of the t-criterion with the number of degrees of freedom of 16 for the 0.05 significance level is 2.12, and the calculated value will be $t_p = 0,106$. As a result of comparing

the value of the t-criterion, we conclude that the difference is unreliable, the hypothesis about the adequacy of the linear model according to the second criterion could be accepted. However, the pairwise interaction in 45 turned out to be significant; therefore, the process under study cannot be described by a linear model. According to [1,4,7], a linear model is not adequate if at least one of the interaction effects turned out to be significant

Conclusion. Based on the above, we come to the conclusion that the linear model cannot be accepted to describe the experimental results, therefore, in further studies to study and describe the optimum region, the linear approximation is insufficient. It is necessary to use second-order planning, which allows one to obtain an idea of the response function using second-degree polynomials. Before describing the process under study with a higher-order model, it is necessary to first make a steep ascent to the optimum region, for which additional experiments were conducted, the results of which are presented in the lower part of the matrix. The change in the material feed rate (factor X5) was chosen as a single step, since in this case the value of the regression coefficient has the greatest absolute value compared to others. The value of the single step for other factors was taken proportional to the value of the adopted step of factor X5. Since the parameters of the optimum region corresponding to the minimum value of the optimization parameter were determined, the step process of the implementation movement with signs replaced by the opposite ones. The experiments conducted according to the steep ascent program showed that the zero point gave the best results, while the unevenness of the heap leveling was 9.50%, i.e. it has the lowest value. The further step process in accordance with the program leads to an increase in the optimization parameter.

The results of the steep ascent give reason to assume that the previously selected center of the experiment is near the optimum region.

In this regard, the center of the experiment was left the same. The validity of this conclusion is also confirmed by the analysis of the signs and absolute values of the regression coefficients. The interval of variation of the factors and the center of the experiment were chosen correctly, since the absolute values of the regression coefficients for the factors are commensurable, while two of them have the (+) sign, and one has the (-) sign.

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