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Parameter optimization of dosator for technique culturs on the quantity intervals, close by to calculation

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S u m m a r y: Results of multifactorial experiments by orthogonal planning for four factors: height and diameter of seed tube, rotary speed of seed disk and velocity of movement machine are presented. Experiment results were analyzed according to generally accepted methods and adequate model was received. Influence of each factor on the quantity intervals, close by to calculation, and optimal value of each factor were determined [19, 20].
K e y w o r d s: the quantity intervals, close by to calculation, influence of factors, optimization.

INTRODUCTION

Sugar beet on Donbasse – one from leading technical culture: in the structure of seeding areas harcovchiny, for example, she occupy in 90-h years about 10% [7, 21, 22] and provide from above 25…30% of profit from plant-growing. By that only behind count accessory production (tops and other) from every hectare received about 35 centners feeding digit, that equivalently growing 35 c/h oats. But in period of transitional economy production of beet field sharply lower, and use hand labour by formed of density planting brought to unprofi tableness of production sugar beet in much economyes. In also time the row of agrarian undertaking of region, where don't to admitted of violations technolog, but hardly adhere to normative agrarian technical receptions of tilling sugar beet independently from weather conditions and economic crisis, annual receive high and constant harvests of sweet roots.

From aim of reliable securing of increasing need of region in sugar for the consumption and processing industry (136…137 thousand ton in year) foresee essential increasing of volume production of sugar row material no only behind count increasing of sowing areas, but and behind count introduction of high effective and energy savings technologs. Foresee distribution of sugar beet in rotation of crops of intense type, the growing of high productive sorts and hybrids. By that is necessary, to the density standing of the roots was on the level 103…105 thousand plants on hectare. In system of processing soil half fallow must be occupy about 75% of the areas. The introduction of integral system defence of plants from the pests, sicknesses and weeds, what includes the chemical processing and the preventive receptions, is appear most economic expediency and ecological safe means of increasing productive of the sugar

beet, but the high quality processing of seeds defence stimulation composition must be obligatory. The of many yeans experience and data of the agronomical science is witness, that high harvests the root – crops it is possible in the all beet seeding economyes of the region, if every toiler is seize of the technolog growing and has be broadly inculcate the scientific working out and the experience of foremost people. In the zone of unstable molstening most high harvests receive after spring winter wheat at occupy fallow, the pea and of many years grasses. In east part of the forest – steppe of the Ukraina is mark positive role of the black fallow in the form of harvest sugar beet. On Ivanovskoy experiment station in the middle after 29 years on the lot with black fallow was received at 38,9 ton/hec root – crops, but at the lots with by vetch-oats mixture, maize on green fodder and the silo – less on 1,5…1,9 ton/hec, that is to say, in the zone of unstable molstening on the fertile chernozem soils better predecessor of sugar beet is appear spring winter wheat, which place after occupy fallow, but also after the pea on grain. In 10-field rotation of crops recommend the such alternation: 1 – the fallow occupied, fallow clean, 2 – spring winter wheat, 3 – sugar beet, 4 – summer grain with sowing of the grasses, 5 – of many years grasses of one year using, 6 – spring winter wheat, 7 – sugar beet, 8 – pea, 9 – spring winter wheat, 10 – maize, sunflower. In the zone of insufficient molstening most favourable water regime has be on the lot with black fallow, that stipulated more high productive of the sugar beet. So, in the middle after 1982…1995 years on Veselopodolskoy station the yield of the sugar beet after spring winter wheat on black fallow compose 41,6 ton/hec. That is say in the zone of insufficient molstening expediency to use such alternation: 1 – fallow black, 2 – spring winter wheat, 3 – sugar beet, 4 – annual cultures on the green fodder and silo, 5 – wheat and rye winter, 6 – maize, 7 – annuals with Sowing of the many years grasses, 8 – the grasses many – and annual, 9 – spring winter wheat, 10 – sugar beet, sunflower, maize on the grain. For farm economyes it is possible to recommend the rotation of crops with short rotation: 1 – black and occupied fallow, 2 – spring winter wheat, 3 – sugar beet, 4 – maize on the grain, 5 – barley with the sowing of many years grasses, grits cultures.

The processing of soil under sugar beet must provide:

– uniformite distribution in the arable layer near to the surface organic remainders of the predecessor (the straw, remainder of the intermediate culture and manure),

– removal of the harmful condensations in the arable and under arable layers, the destruction of the plough sole,

– provoke the shoots of the weeds and their destruction,

– the absorption and the delay of the water of autumnal and wintry sediments,

– sufficient even surface of the field for the sowing.

Distinguish three of the method of the processing of the soil: traditional, in the basis of which lie the plough processing, the soildefence (conserve) and straight the sowing without of the processing soil. The traditional and soildefence of the methods differ in fundamental of the application or of the no application plough, both method use the variants with before sowing or without her. By soildefence of the method distinguish the sowing to the layer from intermediate cultures or to the layer from the remainders of the predecessor. For deep of the loosen expediency use cultivators in aggregate with heavy teeth harrows, to the droughty weather – with the annulate-spur rinks by worker velocity from above 8 km/h. The fundamental processing of the soil is the major reception in the system of the autumn processing of the soil. Her make with the aim the deep of the loosen soil, careful doing up organic and mineral fertilizations, after harvesting remainders, but also the creation of the conditions for improvement of the water– air and nourishing of the regimes and qualitative constructions of the following field works. The early spring loosen of the soil (“closing of the moisture”) necessary make to the period her of the physical ripeness, by what the soil is

loosen, but isn't stick on working organs of the soil processing instruments.

By that with an of importance no to admit losses of a moisture, make even a surface of a field and create of a conditions for before sowing of a processing soil, sowing and care of a sowing. A delay with closing of a moisture on one a day be able bring to productive of a losses in 60…120 t/h of a water and to lowering of an yield on 0,6…1,2 t/h. A thickness of the friable layer must be 2,5…3,0 sm and contain of a lump with a size 10…20 mm. A works expediency productive of a broad seizure aggregate on the draft of a caterpillar tractors.

In the dependence of a type soil and a density of an upper layer in first row of a coupling place heavy or middle a harrows БЗТС-1, БЗСС-1, in second – a sowing harrows ЗБП-0,6 or the paradise harrow ЗОР-0,7. With aim more careful of smoothing surface of a field applay aggregate from a train – harrow ШБ-2,5 in the first row and sowing harrow ЗБП-0,6 or ЗОР-0,7 – to second. In system of the technological operations of an intense technolog early spring loosen and a smoothing of a surface expediently unite in one pair complex operation, using aggregate АРВ-8,1-01,containing a mechanism for simultaneous of an entry of a herbicides. Before sowing processing of a soil make for the loosen of superficial layer to fine lump state on the give depth, creation of condense sowing a couch, destruction a shoots of the weeds. Before sowing processing of a soil appear of structure a part of common technological process – of a sowing sugar beet, its necessary realize without some break in time. For before sowing processing of a soil with middle density and insufficient moisture it is possible use a cultivator УСМК-5,4Б (В), equipped lancet claws, a rotors and passive trains. High productivity and a quality before sowing processing a soil reach by an utilization aggregate АРВ-8,1-02, what provide high a quality of the loosen of soil on give depth of the doing up of a seeds 3…4 cm without intermixing the layers.

The sowing appear one pair from major reception of the technolog growing. Careful implementation all norm demands of a technolog, but namely: sowing in optimum early and condensed of the date, guaranteeing of the uniformite a distribution of the seeds on a length of the row and a depth of doing up, distribution their on sufficiently condense couch and with give intervals appear condition of formed high productive sowings. With an of importance underline, what in good time a construction of sowing stipulated necessary for a received high of a harvest a duration of vegetal season – in the limits 150…160 days from the shoots to the cleaning. For dotted of the sowing after before sowing the processing of the soil broadly utilize mechanical or pneumatic the seeders, provide exact a sowing on one pair grain. Mechanical seeders provide exact a sowing of calibrate the seeds by work velocity 6 km/h. By that necessary provide right selection sowing of discs with the cells, appropriate to size of the seeds. Liqueur – bonbons seeds sowing of the seeder type ССТ by work velocity to 4 km/h. Pneumatic seeder provide more exact sowing by work velocity to 7…8 km/h.

The norma of the sowing seeds is regulate by the mounting appropriate discs, but also by the driving aim on the necessary asterisks of the box transmissions (Tab.1).

Table 1. Regime of the work a seeder ССТ-12В (one-row sowing disc)

Norma of the sowing, p/m of the row	Number of the tooth's on asterisks of the box transmission		Trans missive number on the sowing disc
	leading	driven	
8	12	19	0,158
10	19	26	0,183
11	12	15	0,2
12	21	23	0,218
15	21	19	0,276

The norma of the sowing necessary applay differentiately in the dependence from a germination of the seeds, a level of culture soil, a presence of the pests and further with a calculation on that, to on high level culture of a fields reseive 7…9 shoots, on middle level culture - 9…11 and on low level culture - 12…15 shoots on 1 m of the length row.

Deviation from calculation intervals at agrotechnical demands is admit no more

$\pm$10% [1-19], that is to say quantity intervals, close by to calculation, must be no less than 90% This exponent straightly influences on the harvestly and the expenses of hand labour on to send away “unnecessary” plants.

OBJECTS AND PROBLEMS

The quantity of an intervals, close by to calculation, was determinated by the formula:

$$Y = K_1 / K_2 , \quad (1)$$

where: K_1 – quantity of an intervals, close by to calculation, it was determinated by the formula: $0{,}9S_0 < K_1 < 1{,}1S_o$ (S_0 – calculation interval), K_2 – quantity of measuring intervals in the experiment.

In the capacity of apparatus with vertical disc the sowing of the seeder of CCT-type, which was installed on the special framework over a ribbon of the stand of a generally accepted construction was used. Four factors were varied: height $x_1(h)$ and diameter $x_2(D)$ of a seed tube, peripheral velocities $x_3(v_0)$ of the twirl of a seed disc and $x_4(v_Л)$ the ribbon of the stand.

Factors $x_1(h)$ and $x_2(D)$ were set by of round metal tubes, but factors $x_3(v_0)$ and $x_4(v_Л)$ – change of a reduction ratio of the mechanism the drive (replaceable starlets). The levels of the factors were varied according to the orthogonal planning of the second order for four factors, closen a condition of technological working ability of the dosator, they are presented in Tab.2.

The seeds of sugar beet of the sort “Verhngachsraya-038” of fraction “4,5…5,5” mm by the disc H 125.04.006 with diameter of the cell 6,0 mm and depth 3,3 mm were seeded. The disc with two row of cells the sectors were used, quantity of the measuring intervals – 200.

Experimental data were treated accordingly with the certain methods, recommended for orthogonal planning: Kohren criterion (characterizing homogeneous of variances), Student criterion (show the significance of regression coefficients) and Fisher criterion (pointing on the adequacy of mathematical model) were defined. The adequate regression model of the second order with variables in a code designation is the view:

$$y = b_0 + b_3 x_3 + b_4 x_4 , \quad (2)$$

where: $b_0 = 0{,}1295$; $b_3 = -0{,}0298$; $b_4 = -0{,}0136$.

The seeds of sugar beet of the sort “Verhngachsraya-038” of fraction “4,5…5,5” mm by the disc H 125.04.006 with diameter of the cell 6,0 mm and depth 3,3 mm were seeded. The disc with two row of cells the sectors were used, quantity of the measuring intervals – 200.

Table 2. The levels and intervals of a variation of the factors $x_1 - x_4$

Characteristics	Factors			
	$x_1(h)$, mm	$x_2(D)$, mm	$x_3(v_0)$, m/s	$x_4(v_Л)$,m/s
The basic level, $x_i = 0$	425,0	60,0	0,350	2,000
The interval of variation, I	265,0	28,3	0,177	0,708
The upper level, $x_i = 1$	690,0	88,3	0,527	2,708
The lower level, $x_i = -1$	160,0	31,7	0,173	1,292
The upper star point, $x_i = 1{,}4142$	800,0	100,0	0,600	3,000
The lower star point, $x_i = -1{,}4142$	50,0	20,0	0,100	1,000

Influence of each factor separately on the response function was defined at values of other factors, equal 0, ±1 and ±1,4142. The equation (2) takes a view:

when $x_4 = -1{,}4142$,
$$y_{3.1} = 0{,}1487 - 0{,}0298x_3,$$
when $x_4 = 0$,
$$y_{3.2} = 0{,}1295 - 0{,}0298x_3,$$

when $x_4 = 1{,}4142$,
$$y_{3.3} = 0{,}1103 - 0{,}0298x_3,$$

when $x_3 = -1{,}4142$,
$$y_{4.1} = 0{,}1716 - 0{,}0136x_4,$$

when $x_3 = 0$,
$$y_{4.2} = 0{,}1295 - 0.0136x_4,$$

when $x_3 = 1{,}4142$,
$$y_{4.3} = 0{,}0874 - 0{,}0136x_4. \quad (3)$$

The importance of functions $y_{3.1} - y_{4.3}$ according (3) are computed on the points $x_i = 0$, ± 1, $\pm 1{,}4142$, calculation data are presented in Tab.3

According to the Tab.3 is built graphs, presented on the fig. From theirs is visible, that of the velocities $x_3(v_0)$, $x_4(v_\Lambda)$ function y was depended straightlinely, it being known that with increasing these of factors a response is diminishes (the lines $y_{3.1} - y_{3.3}$, $y_{4.1} - y_{4.3}$).

Table 3. The sequence of calculation functions $y_{3.1} - y_{4.3}$

x_i	0,0298 x_3	$y_{3.1}$ =0,1487-(2)	$y_{3.2}$ =0,1295-(2)	$y_{3.3}$ =0,1103-(2)
1	2	3	4	5
-1,4142	-0,0421	0,1980	0,1716	0,1524
-1,0	-0,0298	0,1785	0,1593	0,1401
0	0	0.1487	0,1295	0,1103
1,0	0,0298	0,1189	0.0997	0,0805
1,4142	0,0421	0,1066	0.0874	0,0682
0,0136 x_4	$y_{4.1}$ =0,1716-(6)	$y_{4.2}$ =0,1295-(6)	$y_{4.3}$ =0,0874-(6)	
6	7	8	9	
-0,0192	0,1908	0,1487	0,1066	
-0,0136	0,1852	0,1431	0,1010	
0	0,1716	0,1295	0,0874	
0,0136	0,1580	0,1159	0,0738	
0,0192	0,1524	0,1103	0,0682	

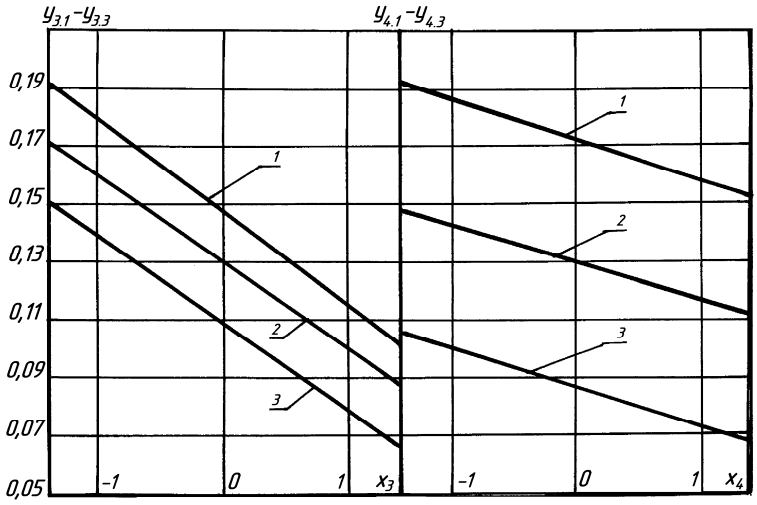

Fig. Graphs of functions $y_{3.1} - y_{4.3}$

PARAMETER OPTIMIZATION OF DOSATOR F0R TECHNIQUE CULTURS ON THE QUANTITY INTERVALS, CLOSE BY TO CALCULATION

The maximum importance function of response on the matrix planning is observed in the experiment № 11: ($y'_{max} = 0{,}212$, when $x_1 = x_2 = x_3 = -1$, $x_2 = 1$). We make the matrix for calculation of maximum importance of the function response Y by quantization of the independent variables [19, 20], Tab.4.

Table 4. The calculation of maximum importance function Y'_{max} of the response

№	b_0 = 0,1295	b_3 = -0,0295	b_4 = -0,0136	$\hat{y}$
1	2	3	4	5
1	1	-1	-1	y'_{max} =0,212
2	1	-1,4142	-1,4142	
3	$b_i x_i$ 0,1295	0,0421	0,0192	0,1908
4	1	-1	-1	
5	$b_i x_i$ 0,1295	0,0298	0,0136	0,1729

The Tab. 4 is constructed as follows: in left column independent arguments x_i and their productions on the regress coefficient b_i are located, in heading – coefficients of regress and their numerical importance. In the line 1 of experiment (that is to say importance of factors x_i) and maximum importance of function response Y from the matrix of planning are represented, further in even lines importance of arguments are represented, and in odd – their productions on corresponding coefficients of regress. In the right last column importance of function $\hat{Y}$, foretell by the equation of regress, are placed. From it is visible, that raise response impossible (the lines 3, 5). Therefore by the coordinates of a special point factorial space take conditions of line 1 Tab. 4 and matrix of planning:

$$Y'_S = 0{,}212;\ x_{1S} = x_{3S} = x_{4S} = -1;\ x_{2S} = 1. \quad (4)$$

So how in the function (2) members of second order is absent, that a surface of response is a plane, without the extreme.

CONCLUSIONS

1. The experimental data were treated with the methods for orthogonal planning second order: Kohren criterion G (characterizing reproduction of the experiments), Student criterion T (show the significance of coefficients regression) and Fisher criterion F (point on the adequacy of the mathematical model). The adequate regression model of the second order with variables in a code designation is in the view:

$$Y = b_0 + b_3 x_3 + b_4 x_4,$$

where: $b_0 = 0{,}1295,\ b_3 = -0{,}0298,$

$b_4 = -0{,}0136$.

2. The influence of each factor on the quantity intervals, close by to calculation, was defined by levels other factor, equal ±1, ±1,4142 and 0. It is presented in equation (2), Tab. 3 and fig. From them it is visible, that of the velocities $x_3(v_0)$, $x_4(v_\Lambda)$ function Y was depended straightlinely, it being known that with increasing these of factors the response is diminishes (the lines $y_{3.1} - y_{3.3}$, $y_{4.1} - y_{4.3}$).

3. The maximum importance function of response on the matrix planning is observed in the experiment №11: ($Y'_{max} = 0{,}21;$ when $x_1 = x_2 = x_3 = -1$, $x_2 = 1$). To raise of the response is impossible (the lines 3, 5 of Tab.4).

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ПАРАМЕТРИЧЕСКАЯ ОПТИМИЗАЦИЯ ДОЗАТОРА ДЛЯ ТЕХНИЧЕСКИХ КУЛЬТУР ПО КОЛИЧЕСТВУ ИНТЕРВАЛОВ, БЛИЗКИХ К РАСЧЕТНОМУ

Виктор Белодедов, Павел Носко, Григорий Бойко, Павел Филь, Марина Мазнева

Аннотация. Представлены результаты многофакторного эксперимента, поставленного по матрице ортогонального планирования для четырех факторов: высоты и диаметра семяпровода, а также скоростей вращения высевающего диска и движения посевного агрегата.

Результаты экспериментов обработаны в соответствии с методикой, характерной для ортогонального планирования, получена адекватная математическая модель процесса, по которой установлено влияние факторов и оптимальные условия высева.

Ключевые слова: количество интервалов, близких к расчетному, влияние факторов, оптимизация.