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SUBSTANTION OF THE PARAMETERS TO TILT THE CAMERA ADVANCED CLEANING SEEDS PASTURE PLANTS

Abstract

To reduce losses and improve the quality of harvesting of pasture plant seeds by isolating biologically valuable seeds and reducing the degree of their injury, it is necessary to re-equip the serial inclined chambers of the combine harvester. By dismantling the necessary components of the inclined chamber with the spacer of the experimental installation, it is possible to study the leveling of the granary biomass by each of the feeding organs separately, and when they are put in place - in a complex.

The principles of reducing the loss of seeds and their injury by preliminary isolation of free seeds from the mown crop mass, as well as pre-threshing destruction of the connection of ripened seeds with the stem are implemented in the design scheme of the combine harvester.

With a quadratic regression equation of four independent variables, we can convert it to canonical form and analyze multi-dimensional view of the response surface in the investigated region of the factor space, and find the zone settings in which the response is extreme.

Sum of squares due to regression (SSR) to complete the destruction of com double μ and the degree of leveling wheatgrass biomass v, is about 93% of the total sum of squares (SST), and for the degree of separation of spikes λ - 89,5%.

Therefore, taking these coordinates for the optimal solution and converting them into natural scale, the following parameters improved feeding channel: supply of biomass q = 2,57 kg / pm; the length of the fracture L = 58,73 cm; angle of attack a = 25,76 corrugation deg.; height of the corrugation h - 19,62 mm

***Key words**: Combine harvester, inclined chamber, threshing of seeds, leveling, biomass, injuries, threshing chamber.*

Introduction

Due to the arid grassland and inconsistent usage is increasing degradation of vegetation and soil cover. In some regions of Kazakhstan and Central Asian republics of the processes of desertification in some cases give rise to dust storm sincrease the area of open sand [1].

In Kazakhstan, a significant proportion are areas of natural grassland, amounting to more than 180 million hectares, which provide cheap food and, therefore, appropriate animal products. However, their food supply is limited due to low productivity, which is due to aridity and irrational use of pasture, lack of proper care and improve the land. The main way to increase wield in arid rangelands is a radical improvement, establishment in their place, seeded hayfields and pastures by over seeding seeds of valuable food plants like wheat grass, adapted to local conditions. Currently, work is continuing on the development and improvement of machinery for cleaning seed pasture plants. However, development of scope of work to restore pasture by reseeding capacity feed seed pasture plants require accelerating the development, deployment and equipping of agriculture seed cleaning machines [2].

Analysis of the current status and trends of the world's leading harvester, theoretical and experimental work performed in the main job of the regulators and download show that to solve the most important economic task of improving the performance of combine harvesters is necessary to

solve a scientific problem of intensifying the process of threshing and separation in combine harvesters [3].

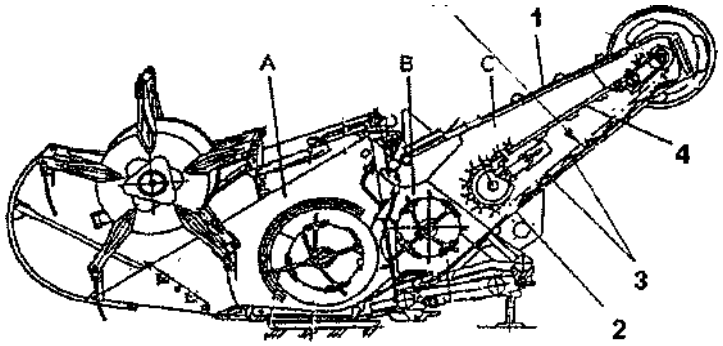

Figure 1 – The tilting camera for harvesting seeds of pasture plants
A - reaper, B - accelerator, C - tilt camera with the combine harvester,
1 – look out cap, 2 – lower shaft, 3 – a device for the destruction of com double wheatgrass, 4 – transporter.

In the Kazakh National Agrarian University developed a promising new generation of camera tilt. In order to adapt the developed feeding channel for harvesting seeds of pasture plants we improved its structural scheme shown in Figure 1 [4,5].

Methods and materials (experimental)

To study the optimal parameters improved feeding channel for harvesting seeds of pasture plants, in particular, methods of wheatgrass our experimental design, which consists in choosing the number and the experimental conditions, necessary and sufficient for the task with the required accuracy. Using the general form of the quadratic model and evaluation of 6-coefficients, we write the multiple regression equation in expanded form for each output measure $\mu = Z_1$, $\lambda = Z_2$ and $\nu = Z_3$, which characterizes the used method of destruction double ears wheatgrass. According to the model structure and obtained the following regression equation of second order:

completeness of the destruction double spikes, %

$$Z_1 = 84{,}51 + 1{,}33333\ x_1 - 5{,}8125\ x_1^2 - 2{,}21667\ x_2 - 9{,}1625 x_2^2 + 0{,}81111\ x_3 - 5{,}6125\ x_3^2 - 1{,}32222\ x_4 - 6{,}9125\ x_4^2 - 0{,}8x1x_2 - 0{,}85\ x_1x_3 - 2{,}3875\ x_1x_4 - 2{,}2625\ x_2x_3 - 1{,}875\ x_2x_4 + 1{,}3\ x_3x_4; \quad (1)$$

separation of wheat, %

$$Z_2 = 3{,}55 + 0{,}255556\ x_1 - 0{,}197917x_1^2 + 1{,}027778\ x_2 + 2{,}352083x_2^2 + 0\ 45\ x_3 + + 1{,}6521x_3^2 + 0{,}34444\ x_4 + 1{,}40208x_4^2 - 0{,}28125\ x_1x_2 - 0{,}29375\ x_1x_3 + 0{,}66875\ x_1x_4 - 0{,}35625\ x_2x_3 + 0{,}15625\ x_2x_4 - 0{,}45625\ x_3x_4; \quad (2)$$

power leveling biomass, %

$$Z_3 = 82{,}14 + 1{,}05\ x_1 - 4{,}44375\ x_1^2 - 1{,}71\ 1\ 1\ 1\ x_2 - 6{,}99375x_2^2 + 0{,}62778\ x_3 — 4{,}34375\ x_3^2 - x_4 - 5{,}29375\ x_4^2 - 0{,}60625\ x_1x_2 - 0{,}65625\ x_1x_3 — 1{,}84375\ x_1x_4 - 1{,}73125\ x_2x_3 - 1{,}44375\ x_2x_4 + 1{,}00625\ x_3x_4. \quad (3)$$

Equations (1) - (3) describe the relationship double ears completeness of destruction, separation, spikes and leveling wheatgrass biomass with independent parameters leveled the unit.

With a quadratic regression equation of four independent variables, we can convert it to canonical form and analyze multi-dimensional view of the response surface in the investigated region of the factor space, and find the zone settings in which the response is extreme.

In the next stage of regression analysis revealed statistically significant effects of factors. The significance of the obtained regression components are characterized by significantly influence the investigated parameters of the device on the completeness of the destruction of com double $\mu = Z_1$, was determined from the calculated values of Student's f-test, absolute values are ordered by their

descending and presented in a Pareto chart. Pareto chart is an effective means of determining what effects have the greatest contribution to the formation of interest on the dependent variable, for example - power leveling wheatgrass biomass Z_3. [6,7].

The greatest influence on the completeness of destruction double ears have wheatgrass in the first place the squares (Q) variable x_2 (Q) - the length of the fracture and x_4 (Q) - the height of the corrugation. This is followed by the pair interaction x_1x_4 (lLby4L) supply of biomass and height of the corrugation, linear (L), or the so-called main effect of x_2 - the length of the fracture, etc. The corresponding bands intersect the vertical line that represents 90% of the confidence level.

Table 1 – Analysis of variance of regression models for rates of destruction of ears wheatgrass

Source variation	Degrees of freedom *df*	Sum of squares *SS*	mean square *MS*	of the ratio of the mean square *F*	p-level of significance for *F*
The completeness of the destruction of corn double wheatgrass Z_1, *%*					
Regression (R)	14	2726.615	194.7582	8.399924	0.001504
The residue (E)	9	208.6714	23.18571		
The full amount (T)	23	2935.286			
Separation of spikes Z2, %					
Regression (R)	14	126.874	9.276711	5.469177	0.007338
The residue (E)	9	15.26563	1.696181		
The full amount (T)	23	145.1396			
The degree of leveling biomass Z_3*,%*					
Regression (R)	14	1603.802	114.5573	8.526813	0.00142
The residue (E)	9	120.9145	13.43495		
The full amount (T)	23	1724.716			

Table 2 – Checking the quality of approximation of the regression models for performance threshing wheatgrass

Statistical	Index value for the criterion of threshing		
	$\mu = Z_1$	$v = Z_2$	$\lambda = Z_3$
Multiple correlation *R*	0,964	0,946	0,964
The coefficient of determination R^2	0,929	0,895	0,930
Adjusted (for *df)* R^2	0,818	0,731	0,821
The standard error	4,815	1,302	3,665
The number of degrees of freedom *df:* k_1; k_2	14; 9	14; 10	14; 11
Fisher's criterion *F*	8,400	5,469	8,527
The level of significance of p to *F*	$1,5 \cdot 10^{-3}$	$7,3 \cdot 10^{-3}$	$1,4 \cdot 10^{-3}$
Durbin-Watson criterion *d*			
Serial correlation			
Note: k_1 *and* k_2 *- the number of degrees of freedom for the numerator and denominator, respectively*			

Sum of squares due to regression (SS_R) to complete the destruction of com double μ and the degree of leveling wheatgrass biomass *v*, is about 93% of the total sum of squares (SS_T), and for the degree of separation of spikes λ - 89,5%.

Assessment of quality of regression models developed for performance threshing wheatgrass received by the laboratory-field data, the multiple correlation coefficients tested *R*, determination R^2 and F-test and Fisher's criterion for the Durbin-Watson *d.* These statistical characteristics and criteria for assessing the quality of the regression equations calculated by computer statistical programs *SPSS 16* and *Statistical 7.0* shown in Table 2.

In Table 2 the coefficient of multiple correlation are significant, are quite high (0,964; 0,946; 0,964) and close to the limiting magnitude ($R \leq 1$), indicating that a high close relationship with the destruction of the investigated parameters and the separation of ears double wheatgrass and wheatgrass biomass leveling. [8].

Results and discussion

The calculated model allowed to define further the optimal area of adjustable parameters of the activator, outside of which the improvement in the completeness of destruction double ears wheatgrass will not bring proportionate effect.

The presence of negative coefficients (b_{11}, b_{22}, b_{33}, b_{44}) of the squares of the variables in the equation for the complete destruction of double ears wheatgrass $\mu = Z_1$ shows that for each of there variables there is an optimal level.

A similar type of response surfaces and lines of equal levels was obtained for the degree of separation of ears ($\lambda = Z_2$) and the degree of leveling the wheatgrass plant material ($v = Z_3$) improved oblique camera.

Investigation of response surfaces using the canonical transformation leads to the following equations:

$$\begin{aligned} Z_1 - 84{,}838 &= -4{,}38166\,\xi_1^2 - 5{,}78731\,\xi_2^2 - 7{,}47413\,\xi_3^2 - 9{,}8569\,\xi_4^2; \\ Z_2 - 3{,}432 &= 2{,}41328\,\xi_1^2 + 1{,}78422\,\xi_2^2 + 1{,}29105\,\xi_3^2 - 0{,}280227\,\xi_4^2; \\ Z_3 - 82{,}398 &= -3{,}35959\,\xi_1^2 - 4{,}44959\,\xi_2^2 - 5{,}73273\,\xi_3^2 - 7{,}53309\,\xi_4^2. \end{aligned} \quad (4)$$

As follows from the first equation (4), response surface $\mu = Z_1$ to complete the destruction of corn double wheatgrass has a maximum equal to 84.8%, since the signs of all coefficients of the canonical equation is negative. Response surface for the separation of ears wheatgrass $\lambda = Z_2$ has a saddle point at which the response is equal to 3.4%, as coefficients of the second canonical equation (4) have different signs (three coefficients are positive, one negative). The response to the degree of leveling the wheatgrass plant mass $v = Z_3$ at a stationary point as a maximum, equal to 82.4%, since all the coefficients of the third equation (4) are negative.

Thus, all the coordinates of singular points of the response Z_1, Z_2, Z_3, lie in the experimental and slightly differ in magnitude for completeness of destruction of stalks double ears $\mu = Z_1$ and the degree of leveling wheatgrass biomass $v = Z_3$. Therefore, taking these coordinates for the optimal solution and converting them into natural scale, the following parameters improved feeding channel:

–supply of biomass q = 2,57 kg / pm;
–the length of the fracture L = 58,73 cm;
–angle of attack a = 25,76 corrugation deg.;
–height of the corrugation h - 19,62 mm

at which the output quality of threshing wheatgrass the following values: complete destruction of ears double $\mu = Z_1$ = 84,8%; degree separation ears $\lambda = Z_2$ = 3,5%; degree of uniform distribution of plant mass wheatgrass $v = Z_3$ = 82,4% .

Conclusion

By dismantling the necessary components of the inclined chamber with the spacer of the experimental setup, it is possible to investigate the coefficient of leveling of the biomass of the

wheatgrass by each of the above feeding organs separately, and when putting them into place - in the complex.

Experiments are carried out in triplicate repetition on the sheaf's coarse mass. The moisture content of seeds and straw, the length of the stems is determined by the existing method.

The application of the proposed technique to the device allows the most accurate, objective evaluation and determination of the numerical values of the leveling factor of the harvesting machines by the working bodies, in which the coefficient of leveling of the biomass of the gill is changed.

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ЖАЙЫЛЫМ ШӨПТЕРДІҢ ТҰҚЫМЫН ЖИНАУҒА АРНАЛҒАН ЖЕТІЛДІРІЛГЕН КӨЛБЕУ КАМЕРАНЫҢ ПАРАМЕТРЛЕРІН НЕГІЗДЕУ

Аңдатпа

Биологиялық құнды тұқымдарды алу және олардың жарақаттану дәрежесін төмендету есебінен жайылымдық өсімдіктердің тұқымдарын жинау сапасын арттыру және шығындарды азайту үшін астық жинайтын комбайнның сериялық көлбеу камераларын қайта жабдықтау қажет. Көлбеу камераның қажетті эксперименттік құрылғыны орнатумен бөлшектей отырып, жайылым өсімдіктерінің биомассасын әрқайсысымен бөлек, ал оларды бір жерге орнатқан кезде - кешенде зерттеуге болады.

Комбайнның құрылымдық схемасында тұқым шығынын азайту және оларды жарақаттау принциптері егіннің шабылған массасынан бос тұқымдарды алдын-ала алу, сондай-ақ тұқымдардың сабақтармен байланысын алдын-ала бұзу арқылы жүзеге асырылады.

Квадраттық регрессия теңдеуін қолдана отырып, біз оны канондық түріне айналдырып, зерттелетін факторлық кеңістіктегі бетінің көп өлшемді көрінісін талдай аламыз, сонымен қатар экстремалды маңызды болатын параметрлерін таба аламыз.

Тұқымның сабақтардан толығымен бөлініп шығуы үшін μ , регрессияға (SSR) байланысты квадраттардың қосындысы және V бидайдың биомассасын тегістеу дәрежесі квадраттардың жалпы санының (SST) шамамен 93% құрайды, ал сабақтардың бөліну дәрежесі үшін λ - 89,5% құрайды.

Сондықтан, осы координаттарды оңтайлы шешім ретінде қабылдап, оларды натуралды масштабқа айналдыра отырып, жетілдірілген көлбеу камераның келесі параметрлері алынды: биомасса беруі q = 2,57 кг/сағ; бөліну аймағының ұзындығы L = 58,73 см; гофрдың бұрышы a = 25,76 град.; гофр биіктігі h = 19,62 мм.

Кілт сөздер: Комбайн, көлбеу камера, тұқым бастыру, тегістеу, биомасса, шығын, бастыру камерасы.

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ОБОСНОВАНИЕ ПАРАМЕТРОВ УСОВЕРШЕНСТВОВАННОЙ НАКЛОННОЙ КАМЕРЫ ДЛЯ УБОРКИ СЕМЯН ПАСТБИЩНЫХ РАСТЕНИЙ

Аннотация

Для снижения потерь и повышения качества уборки семян пастбищных растений за счет выделения биологически ценных семян и снижения степени их травмирования необходимо переоборудовать серийные наклонные камеры зерноуборочного комбайна. Демонтируя необходимые компоненты наклонной камеры с установкой экспериментальной поверхности, можно изучать выравнивание биомассы пастбищных растений каждым из органов подачи отдельно, а при их установке на место - в комплексе.

В конструктивной схеме зерноуборочного комбайна реализованы принципы уменьшения потерь семян и их травмирования путем предварительного выделения свободных семян из скошенной массы урожая, а также предварительного разрушения связи созревших семян со стеблем.

Используя квадратное уравнение регрессии из четырех независимых переменных, мы можем преобразовать его в каноническую форму и проанализировать многомерный вид поверхности отклика в исследуемой области факторного пространства, а также найти настройки зоны параметров, в которых отклик имеет экстремальное значение.

Сумма квадратов, обусловленных регрессией (SSR) для полноты разрушения двойчатки колосьев μ и степени разравнивания биомассы житняка v, составляет около 93% от общей суммы квадратов (SST), а для степени отрыва колосьев λ - 89,5%.

Следовательно, приняв эти координаты за оптимальное решение и преобразовав их в натуральный масштаб, получили следующие параметры усовершенствованной наклонной камеры: подача биомассы q = 2,57 кг/ч; длина зоны разрушения L = 58,73 см; угол атаки гофры a = 25,76 град.; высота гофры h = 19,62 мм

Ключевые слова: Комбайн, наклонная камера, обмолот семян, измельчение, биомасса, потери, молотильная камера.