

Determination of the main parameters and operating mode of a hexagonal mixing drum with additional agitators

H.G.Diyorov

Termiz state engineering and agrotechnologies university, Termiz, Uzbekistan.

Abstract. The article provides determination of the main parameters and operating mode of a hexagonal mixing drum with additional agitators. This indicates the reliability of the data obtained during experimental studies, since the time of mixing treated seeds in a hexagonal mixing drum affects the performance of seed treatment. The results obtained are influenced by other factors, which also play an important role in the values of the productivity of seed dressing in a hexagonal mixing drum, therefore, with the values of the mixing time of treated seeds in a hexagonal mixing drum from its base value to its maximum value, the productivity of seed dressing leaving the hexagonal mixing drum was obtained with a slight decrease, for example, by 0.3 t/hour.

Key words: seeds, dressing, complex microfertilizers, individual microelements, productivity, mixer, factors, tubular bars, mixing time.

Introduction. Modern pre-sowing treatment of seed (planting) material is a more complex measure than dressing, since during this process, in addition to fungicidal or insect-fungicidal disinfectants, protective and stimulating materials containing plant growth stimulants, complex microfertilizers, individual microelements and film-forming substances that provide both protection and stimulation of plant growth processes.

Increasing the yield of agricultural crops should be based on reliable protection of plants from pests, diseases and weeds, through the use of highly effective, low-toxic, environmentally friendly chemical and biological agents [1].

Currently, a certain set of physical, chemical and biological factors has been tested that make it possible to have an active influence on the productivity of agricultural crops. Many years of practice and world experience prove that about 30% of the preserved harvest depends on high-quality seed dressing with a correctly selected disinfectant [2].

Cotton seeds sown to be treated must comply with the state standard [3] in Table 1 in terms of quality indicators.

Table 1.

Quality indicators of sowing seeds

The name of indicators	Norm, %		
	For hairy seeds	For slightly hairy seeds	For bare seeds
Germination, no less	90,0	90,0	90,0
Humidity (mass fraction of moisture), no more	10,0	10,0	10,0
Clogging (mass fraction of mineral and organic litter), no more	0,7	0,5	0,3

Mechanical damage, no more	7,0	8,0	8,0
Pubescence, no more	-	2,5	0,5
Residual fiber, no more than:			
- for the pubescent	0,8		
- for naturally naked	0,4		

The quality of dressing depends on many factors related to the condition of the seed, the characteristics of the dressing agent and its formulation, and the design and technological design of the dressing machine. It should also be noted that high-quality etching is only possible if it is performed by qualified personnel, taking into account the correct combination of all the listed components.

Methods. In the laboratory conditions of Paxtasanoat ilmiy markazi JSC, experiments were carried out to determine the completeness of dressing of pubescent cotton seeds on a drum mixer, inside of which strips made of ferrous metal sheets were installed. In the experiments, pubescent seeds of the selection variety S-6524, prepared for dressing, were used. The experimental results are shown in Table 2.

Table 2.

The influence of the angle of installation of the slats relative to the walls of the drum for the completeness of dressing of pubescent cotton seeds

Rotation frequency of the drum mixer, rpm	Angle of installation of the slats relative to the drum walls, degrees	Completeness of treatment of pubescent seeds, %
11	90	78
	120	92
	150	83

As can be seen from the results of the experiment (Table 2), there was an increase in the degree of sliding along the surface of the bar when the angle of installation of the bar for auxiliary mixing was 90° relative to the drum wall, when the angle of installation of the bar to the drum wall was 150°, auxiliary mixing bars installed in relation to walls of the hexagonal mixing drum, an increase in the sliding speed along the surface of the slats was observed. When the auxiliary mixing bars were set at an angle of 120° degrees, the completeness of treatment was 92 percent due to the high degree of friction of the seeds on the surface of the bars [4].

However, the laboratory experiments were carried out incompletely, since the work carried out did not take into account the productivity of the mixer, the number of installed slats and their main parameters - length, height, location of the slats inside the drum, etc. In addition, the slats have a passive effect on seed mixing, since the seed on their surface is located in heaps and falls from them faster and is slightly loosened.

Based on the above, our research task is to improve the quality of cotton seed dressing by increasing the intensity of its mixing inside a hexagonal mixing drum.

The problem is solved by the fact that the mixing working body is made in the form of a hexagonal cylinder, inside of which, instead of slats, round pipes arranged in a checkerboard pattern will be fixed along the length of the cylinder, assembled, for example, in the form of a

lattice, with gaps between the pipes from the condition of gradual falling out and mixing pubescent seeds with a disinfectant [5].

In this case, the length of round pipes, diameter, quantity, angles of their installation are selected from the condition of the maximum required quality of mixing of pubescent cotton seeds. The essence of the developed mixing drum for treating pubescent cotton seeds is illustrated by drawings, where Fig. 1 shows a general view of the mixing drum, Fig. 2 drum with round pipes fixed from the inside and a view of the installation of round pipes on rolling bearings.

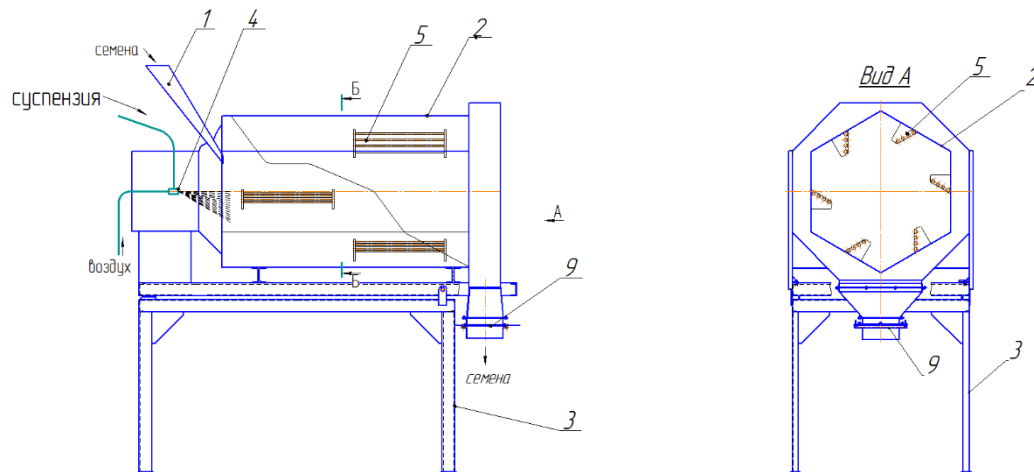


Fig.1. General diagram of a hexagonal mixing drum

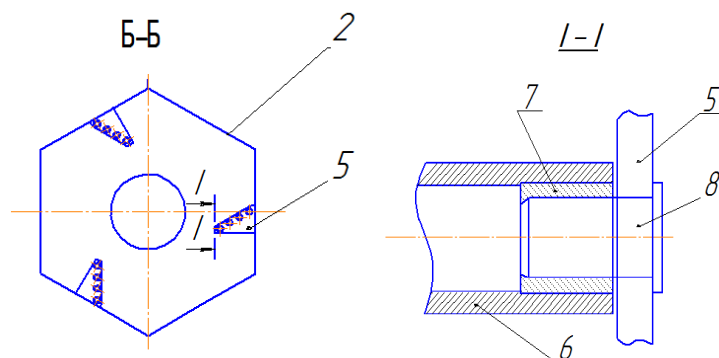


Fig. 2. Section of the drum and view of round pipes installed, for example, on rolling bearings

The developed dresser for pubescent seeds (Fig. 1 and 2) will contain a seed tray 1, a mixing hexagonal cylindrical drum 2 mounted on a frame 3, a nozzle 4, gratings 5, round pipes 6. To reduce friction and possible rotation of round pipes 6 under the influence of force gravity of the pickled pubescent seeds, they can be installed on gratings on rolling bearings 7 using an axis 8. There is an unloading chamber 9 to release the pickled seeds.

The technological process of the device is performed as follows.

Seeds through seed tray 1 enter a mixing hexagonal cylindrical drum 2 mounted on frame 3. A nozzle 4 is installed under the tray to spray the suspension. As the sprayed suspension passes from the torch zone, the seeds are covered with drops of liquid and then, passing inside the hexagonal cylindrical drum 2, are mixed. When the multifaceted cylindrical drum 2 rotates, the seeds are mixed until uniformly coated with the dressing agent. Fixed inside a hexagonal

cylindrical drum 2, assembled in the form of a lattice 5, round pipes 6 serve to wrap the seeds while mixing to evenly distribute the drug over the surface of the seeds. In this case, pipes installed at different angles create radial and axial flows of seeds, as well as intensive wrapping as seeds gradually fall between the gaps of round pipes, and thereby ensure a convective mixing process. Pipes 6 can be installed on rolling bearings 7 using an axis 8. The processed seeds from the hexagonal cylindrical mixing drum fall out through the unloading chamber 9.

Fixed in a checkerboard pattern inside the hexagonal cylindrical mixing drum, round pipes fixed in the form of a lattice create additional mixing of seeds during its rotation, since as the round pipes are raised and the angle changes, the pickled seeds gradually fall out into the gaps between the pipes, which is impossible when installing a bar [6, 7], and this ensures uniform distribution of the suspension over the surface of the seeds with increased processing efficiency.

Discussion. To finally determine the main parameters and operating mode of a hexagonal mixing drum with additional mixers, experimental studies were carried out using mathematical experimental planning, and a full-factorial experiment plan B3 was selected [6, 7]. The factors that have a significant impact on the process of mixing treated seeds are the rotation speed of the hexagonal drum X1, the angle of installation of the tubular bars to the walls of the hexagonal drum X2 and the mixing time of the treated seeds X3. The response criteria were the completeness of seed treatment and the performance of seed treatment.

The intervals for varying factors were selected taking into account the influence of each factor on the optimization criteria and based on the results of preliminary studies [6].

After implementing the planning matrix, processing the experimental results, calculating regression coefficients, assessing their significance, checking the reproducibility of the process and the adequacy of the resulting equation were carried out according to the well-known [6] method on a computer using a computer.

Factor levels and variation intervals are given in Table 3.

Table 3

Levels of factors and intervals of their variation

№	Factors	Unit change	Designation factors		Inter-variation shafts	Levels of variation		
			Natural Coding	Coded		-1	0	+1
1	Hex Drum Speed		ω	X ₁	3	7	10	13
2	Coal installation of tubular strips to the walls of the hexagonal drum	rpm	α	X ₂	30	90	120	150
3	Mixing time for treated seeds	hail	t	X ₃	58	40	98	156

After processing the experimental results and assessing the significance of the regression coefficients, the following regression equations were obtained that adequately describe:

Completeness of seed treatment:

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-4, ISSUE-12

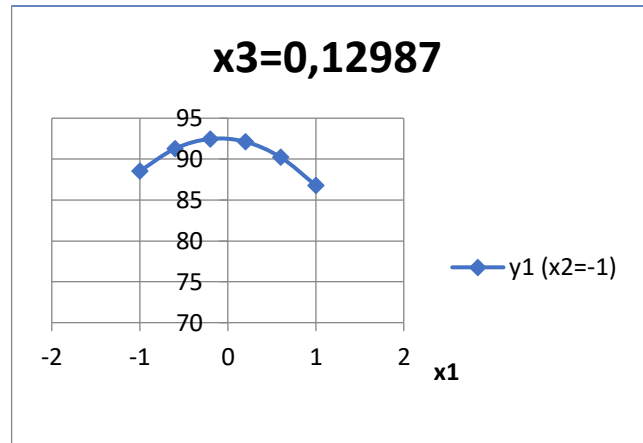
$$Y_1 = 96,746 + 0,470 X_1 + 2,060 X_2 + 4,593 X_3 - 4,829 X_1^2 + 1,542 X_1X_2 + 1,550 X_1X_3 - 2,579 X_2^2 + 0,617 X_2X_3 - 7,946 X_3^2$$

Seed productivity:

$$Y_2 = 4,262 + 0,177 X_1 + 0,170 X_3 - 0,273 X_1^2 - 0,240 X_3^2$$

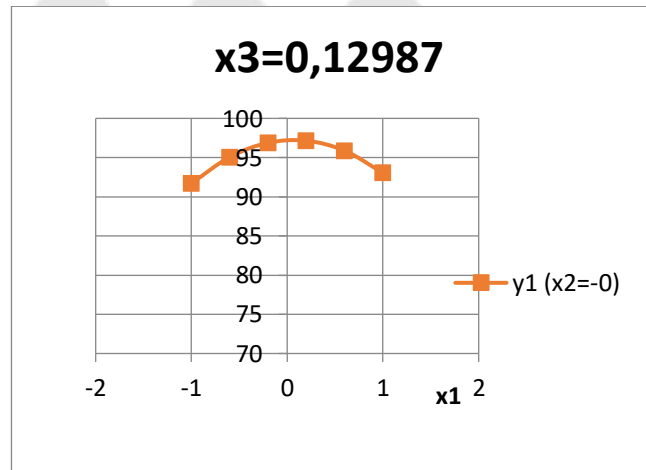
For clarity, Figures 3 and 4 show graphs of changes in output parameters depending on changes in input parameters selected for mathematical planning of experiments.

X ₁	X ₂	X ₃	Y ₁
-1	-1	0,129866	88,53104
-0,6	-1	0,129866	91,27332
0,2	-1	0,129866	92,47032
0,2	-1	0,129866	92,12204
0,6	-1	0,129866	90,22847
1	-1	0,129866	86,78963



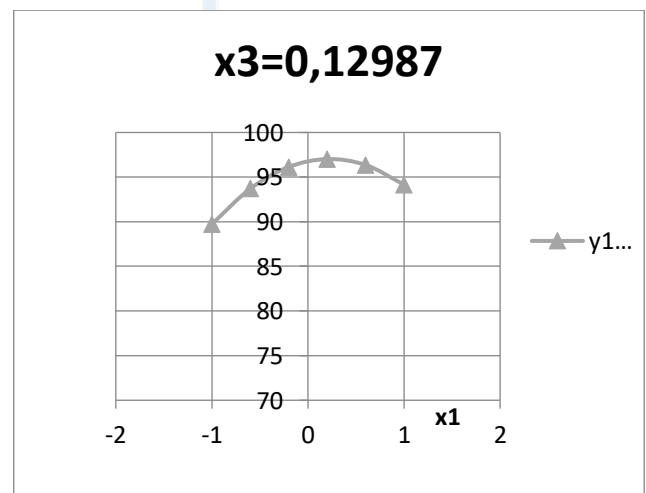
A)

X ₁	X ₂	X ₃	Y ₁
-1	0	0,129866	91,70817
-0,6	0	0,129866	95,06725
-0,2	0	0,129866	96,88105
0,2	0	0,129866	97,14956
0,6	0	0,129866	95,8728
1	0	0,129866	93,05076



B)

X ₁	X ₂	X ₃	Y ₁
-1	1	0,129866	89,7273
-0,6	1	0,129866	93,70318
-0,2	1	0,129866	96,13377
0,2	1	0,129866	97,01909
0,6	1	0,129866	96,35913
1	1	0,129866	94,15388

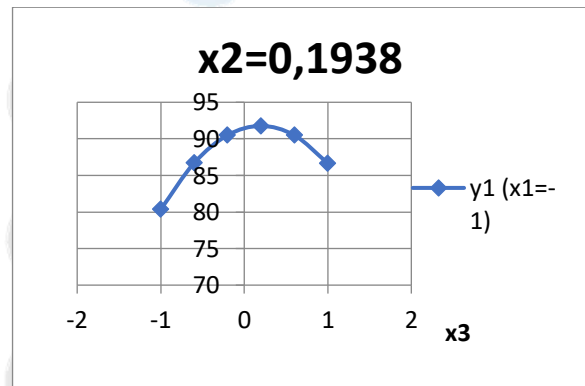


V)

Fig.3. Graphs of changes in the completeness of seed treatment depending on the rotation speed of the hexagonal drum with fixed values of other input factors

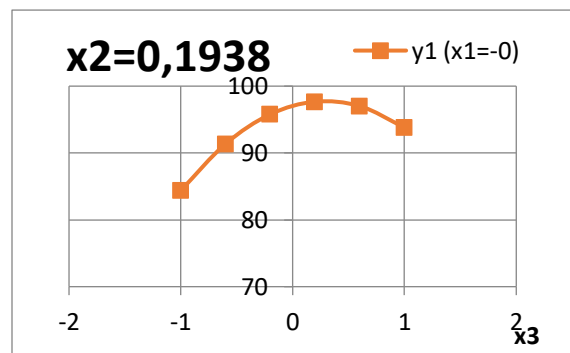
As can be seen from Fig. 3, from the graphs of changes in the completeness of seed dressing depending on the rotation speed of the hexagonal drum with fixed values of other input factors, an increase in the rotation speed of the hexagonal mixing drum from its minimum value to the base value, the completeness of dressing of seeds leaving the hexagonal mixing drum, tends to increase. With an increase in the rotation speed of the hexagonal mixing drum from its base value to its maximum value, the completeness of seed dressing leaving the hexagonal mixing drum tends to decrease. However, the difference in the completeness of seed treatment is insignificant at a fixed value of $X_2 = 0$, as can be seen from the graph shown in Fig. 3 with the value $X_1 = -1$, the completeness of dressing of seeds coming out of the hexagonal mixing drum is equal to 91.7%, with a value close to the base $X_1 = 0.2$, the completeness of dressing of seeds coming out of the hexagonal mixing drum is 97.1%, and at maximum value $X_1 = +1$, the completeness of treatment of seeds leaving the hexagonal mixing drum is 93.0%. From these data it follows that the desired installation angle of additional tubular strips to the walls of the hexagonal mixing drum is within 120° .

x1	x2	x3	y1
-1	0,193802	-1	80,34195
-1	0,193802	-0,6	86,69242
-1	0,193802	-0,2	90,50017
-1	0,193802	0,2	91,7652
-1	0,193802	0,6	90,48751
-1	0,193802	1	86,6671



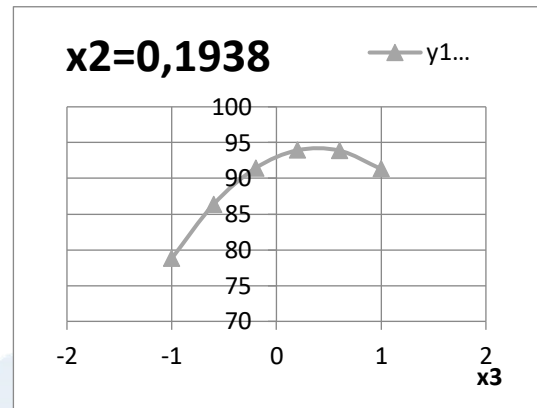
A)

x1	x2	x3	y1
0	0,193802	-1	84,38979
0	0,193802	-0,6	91,36026
0	0,193802	-0,2	95,78801
0	0,193802	0,2	97,67304
0	0,193802	0,6	97,01535
0	0,193802	1	93,81494



B)

x1	x2	x3	y1
1	0,193802	-1	78,77963
1	0,193802	-0,6	86,3701
1	0,193802	-0,2	91,41785
1	0,193802	0,2	93,92288
1	0,193802	0,6	93,88519
1	0,193802	1	91,30478



V)

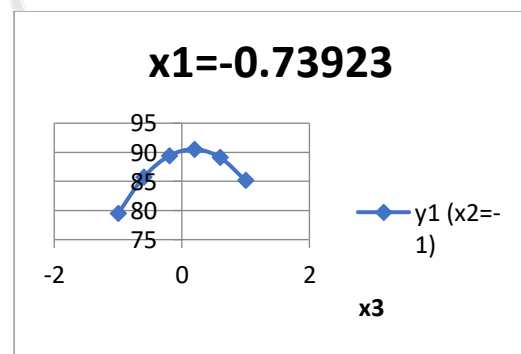
Fig.4. Graphs of changes in the completeness of seed dressing depending on the time of mixing the treated seeds in a hexagonal mixing drum with fixed values of other input factors.

As can be seen from Fig. 4, from the graphs of changes in the completeness of seed dressing depending on the time of mixing the treated seeds in a hexagonal mixing drum, with fixed values of other input factors, an increase in the mixing time of the treated seeds in a hexagonal mixing drum from its minimum value to the base value, the completeness of dressing of seeds leaving hexagonal mixing drum tends to increase and is in the range of 91.7-97.6%. With an increase in the mixing time of the treated seeds in the hexagonal mixing drum from its base value to the maximum value, the completeness of the treatment of seeds leaving the hexagonal mixing drum also tends to increase, but with a slight decrease in values close to the maximum value of this factor and decreases to 86.1- 91.3%.

This indicates the reliability of the data obtained during experimental studies, since logically, the longer the mixing time of the treated seeds in the hexagonal mixing drum, the better the mixing and the higher the completeness of seed treatment. However, in the obtained results there is the influence of other factors, which also play a significant role in the values of the completeness of seed dressing in a hexagonal mixing drum, therefore, with the values of the mixing time of treated seeds in a hexagonal mixing drum from its base value to its maximum value, the completeness of seed dressing leaving from a hexagonal mixing drum, was obtained with a slight decrease, for example, by 5-8%.

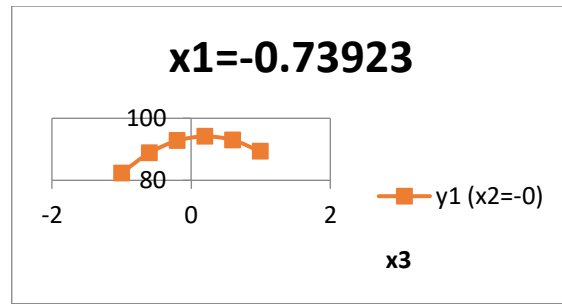
Thus, we can say that the longer the mixing time of the treated seeds in the hexagonal mixing drum, the better the mixing of the treated seeds and the higher the completeness of seed treatment.

x1	x2	x3	y1
-0,73923	-1	-1	79,48438
-0,73923	-1	-0,6	85,70189
-0,73923	-1	-0,2	89,37669
-0,73923	-1	0,2	90,50876
-0,73923	-1	0,6	89,09812
-0,73923	-1	1	85,14475



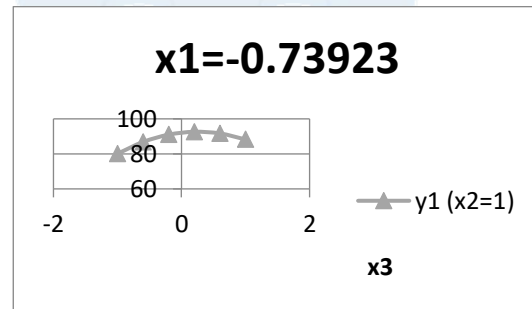
A)

x1	x2	x3	y1
-0,73923	0	-1	82,36648
-0,73923	0	-0,6	88,83079
-0,73923	0	-0,2	92,75239
-0,73923	0	0,2	94,13126
-0,73923	0	0,6	92,96742
-0,73923	0	1	89,26085



B)

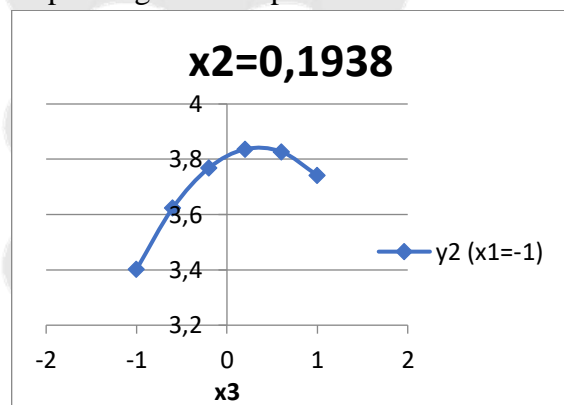
x1	x2	x3	y1
-0,73923	1	-1	80,09058
-0,73923	1	-0,6	86,80169
-0,73923	1	-0,2	90,97009
-0,73923	1	0,2	92,59576
-0,73923	1	0,6	91,67872
-0,73923	1	1	88,21895



V)

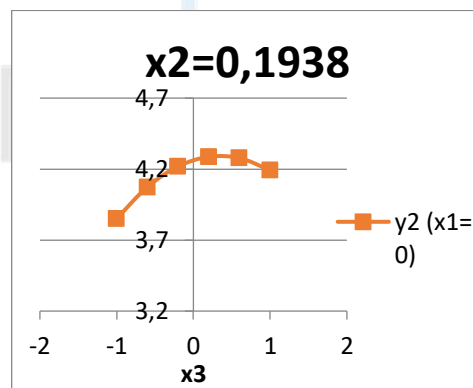
Fig.5. Graphs of changes in the cleaning effect depending on the input factors

x1	x2	x3	y2
-1	0,193802	-1	3,402
-1	0,193802	-0,6	3,6236
-1	0,193802	-0,2	3,7684
-1	0,193802	0,2	3,8364
-1	0,193802	0,6	3,8276
-1	0,193802	1	3,742



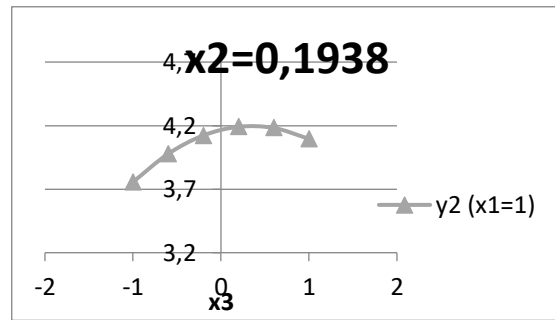
A)

x1	x2	x3	y2
0	0,193802	-1	3,852
0	0,193802	-0,6	4,0736
0	0,193802	-0,2	4,2184
0	0,193802	0,2	4,2864
0	0,193802	0,6	4,2776
0	0,193802	1	4,192



B)

1	0,193802	-1	3,756
1	0,193802	-0,6	3,9776
1	0,193802	-0,2	4,1224
1	0,193802	0,2	4,1904
1	0,193802	0,6	4,1816
1	0,193802	1	4,096



V)

Fig.6. Graphs of changes in the productivity of seed dressing depending on the time of mixing the treated seeds in a hexagonal mixing drum with fixed values of other input factors

As can be seen from Fig. 6 from the graphs of changes in the productivity of seed dressing depending on the time of mixing the treated seeds in a hexagonal mixing drum with fixed values of other input factors, increasing the time of mixing the treated seeds in a hexagonal mixing drum from its minimum value to the base value. The productivity of seed treatment coming out of the hexagonal mixing drum tends to increase and is in the range of 3.8-4.2 t/hour. With an increase in the mixing time of the treated seeds in the hexagonal mixing drum from its base value to the maximum value, the productivity of the treatment of seeds leaving the hexagonal mixing drum also tends to increase, but with a slight decrease in the values of this factor close to the maximum value, at minimum values of the drum rotation speed decreases to 3.7 t/hour. At basic and maximum values of the rotation speed of the hexagonal mixing drum, the productivity indicators are within 4.0 t/hour..

Conclusions. This indicates the reliability of the data obtained during experimental studies, since the time of mixing treated seeds in a hexagonal mixing drum affects the performance of seed treatment. The results obtained are influenced by other factors, which also play an important role in the values of the productivity of seed dressing in a hexagonal mixing drum, therefore, with the values of the mixing time of treated seeds in a hexagonal mixing drum from its base value to its maximum value, the productivity of seed dressing leaving the hexagonal mixing drum mixing drum was obtained with a slight decrease, for example, by 0.3 t/hour.

LITERATURE

1. Kuchkarov Kh.M., Akramov A.A., Abdugabborov Sh. PDI 54 -2015 Recommendation on the treatment of seeds.
2. <https://www.syngenta.kz/rekomendacii-po-tehnologii-obrabotki-semennogo-materiala>.
3. O'z DSt 663:2017 Sowing seeds. Technical conditions.
4. Akramov A.A. and others. ITH, Subject No. 2012 "Development of a seed treatment machine without drugs and determination of acceptable sizes." Tashkent - 2020. 18 p.
5. Kuliev T.M., Akramov A.A., Nazirov R.R., Dyorov Kh.G. and Esanov A.A. Patent No. FAP 01900 "Buttermilk Seed Processing Plant", 04/29/2022.6. Vedenyapin G.V. General methodology of experimental research and processing of experimental data. M, 2003.
7. Rumshinsky L.Z. Mathematical processing of experimental results. M. 2009