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SCIENTIFIC RESULTS OF ETCHED GRAIN SEEDS MACHINE

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Abstract

The article poses the main problem of the loss of seed germination during its storage in granaries. During storage, microorganisms multiply in grain, which not only worsen the grain yield, but also reduce the quality of the product. The most harmful and resistant species are found among the pests of grain stocks. The chemical method is one of the effective measures for pest control - which is the disinfection of seed material from external and internal infection, as well as pathogens of various bacterial and fungal diseases, spreading through seeds, soil and planting material. Such treatment protects crops from damage, contributing to the preservation of up to 30-50% of the crop. The equipment used in organizations for seed treatment does not always meet modern agrotechnical requirements; therefore, the authors have developed a technological scheme and design of an installation for disinfecting grain in a stream when storing it. The test results of the proposed technical device allow us to conclude about the appropriateness of its use.

Key words*: etched grain seeds, disinfection, continuous flow.*

INTRODUCTION

Cereals are one of the most important groups of cultivated plants in human economic activity, giving primarily grain, which is the main food for humans and feed for farm animals (Antipov, 2017). In the world, the loss of grain from pests is enormous. Every year, when storing grain in granaries, losses from pests amount to 5-7% of the harvest. Among the pests of grain stocks, there are the most harmful and resistant species, which include: barn weevils, mites, flour beetles, barn moth, mill moth and other species (Kukharev, 2017).

As a result of the vital activity of pests, not only does the mass of products decrease, but their quality is significantly reduced. They become lumpy and unsuitable for human consumption and livestock feed. Seed germination is noticeably reduced. So, with mass reproducetion of barn mites for 1-2 months, the loss of germination of wheat and rye seeds is more than 50%.

Timely and effective implementation of protective measures allows you to preserve not only the yield, but also the quality of the product.

MATERIALS AND METHODS

Grain disinfection is carried out using physical, mechanical and chemical methods. The first method includes:

- disinfection of grain by cooling, consists in maintaining a low temperature, which affects the life expectancy of grain pests;
- thermal action (drying) is often used when it is necessary to simultaneously reduce the moisture level of the grain mass. However, the use of this method is not effective when processing seed material, since it reduces the seed quality of the grain. In addition, some grain pests are resistant to high temperatures (Gorelov, 2020);
- cleaning of contaminated raw materials, which is carried out by separating them. The main disadvantage of this method is that only those pests that live in the intergranular space are removed from the grain.

Chemical methods are currently the most common methods of protecting grain storage. One of the most effective measures is seed dressing. Seed dressing is the disinfection of seed material from external and internal infection, as well as from pathogens of various bacterial and fungal diseases that spread through seeds, soil and planting material (Kukharev, 2015).

It is quite possible to disinfect cereal seeds with dressing agents such as Raxil, KS on machines that are at the disposal of Russian farms: PSSh 5, PS 10, PS 10A, Mobitox Super, sets of stationary equipment for seed plants KPS 10, K 618, K 619, as well as machines of foreign firms, supplied as part of grain cleaning complexes such as "Petkus", "Hyde" and others (Kireev IM). However, the listed equipment does not meet modern agrotechnical requirements, therefore, for this purpose, the Department of Mechanization of Technological Processes in the Agroindustrial Complex of the Penza State Agrarian University has developed a technological scheme and a design of a device for disinfecting grain in a stream when storing it.

When performing this work, standard techniques were used using the classical provisions of theoretical mechanics, resistance of materials, theory of mechanisms and machines, mathematical modeling. (Machnev, 2016; Machneva, 2018) The development of mathematical models of the interaction of seeds with an installation for disinfecting grain in a stream during storage and subsequent experimental studies were carried out on the basis of planning multifactor experiments and regressive analysis of experimental data with using Statistica and Matlab programs (Machnev, 2019).

The unit is designed for disinfection of grain in the flow with Prostor insect-acaricide. The installation allows processing grain with various concentrations of working solutions - from processing directly with an emulsion concentrate (15 ml of Prostor) to processing with a solution prepared in a ratio of 1 part Prostor and 4 parts of water (15 ml Prostor + 60 ml water).

The plant can be installed almost anywhere there is grain flow. This can be the head of an elevator, a dumping carriage (cart). It is also possible to mount the sprayer above the conveyor belt (Figure 1).

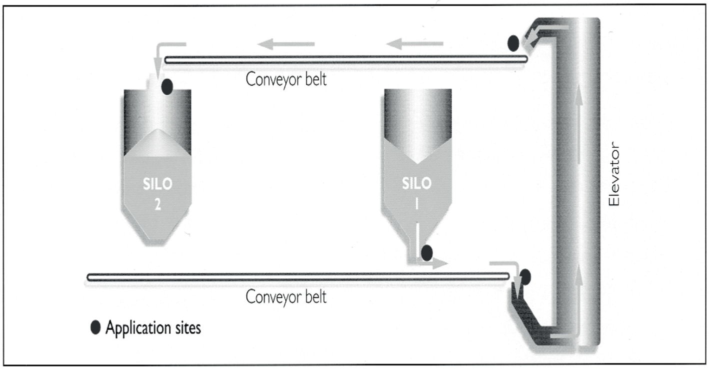

Figure 1. Installation of the proposed equipment

The unit is equipped with a fully digital control, which allows you to accurately set and control the instantaneous consumption of the drug. This makes it possible to process grain in a flow from 20 tons per hour to 500 tons per hour. In this case, two parameters are used as adjustable parameters: instantaneous flow rate and concentration of the working solution. Figure 2 shows a laboratory setup, which contains: a supporting base 1, on which a belt conveyor 4 is attached, which is driven by an electric motor 3. Above the conveyor, there is a seed hopper 5 and a ramp 7 with nozzles 8. At one end of the ramp, a pressure gauge 10 is installed for pressure control and bypass valve 9, which dump excess solution into the pesticide reservoir 12. At the other end of the ramp, a pressure line 6 is attached.

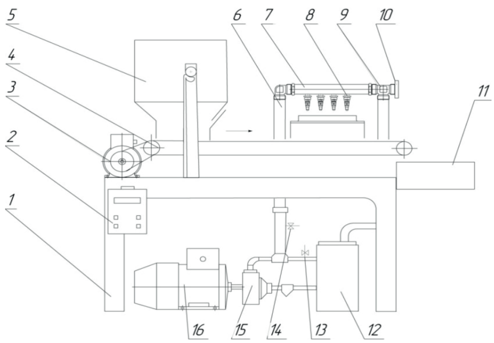

Figure 2. Installation for disinfection of grain in a stream when storing

The main operating mode is sequential. In this mode, 4 sprayers work alternately, providing a continuous flow of the preparation onto the grain.
In the event of a clogged sprayer, it is possible to turn off and redistribute the working solution flow to other sprayers.
There are currently 2 installation options:
- With control of drug consumption from a computer
- With control of drug consumption from the control controller console.

The installation also provides:
- automatic pressure regulation, which facilitates the work of maintenance personnel
- modes of checking the clogging of nozzles.

RESULTS AND DISCUSSIONS

During the screening experiment, the three most significant factors were identified, which were fixed in the studies at the following levels of variation (Table 1).

Table 1. Factors influencing the etching process with the investigated apparatus and the levels of their variation

Designation and namefaktingtori	Factor levels			The interval is variedniya
	Fundamentals Noah	Upper	Lower	
X1 - H -Youhoneycomb mouth-Fore newbitches, mm	350	400	300	fifty
X2 -Vt - Conveyor speed, m / s	0.3	0.5	0.1	0.2
X3 -Pcr - Nozzle pressure, MPa	0.32	0.36	0.28	0.04

Three-factor experiment matrix and its results are presented in Table 2.

Table 2. Matrix and results of three factor experiment

No.	*x1*	*x2*	*x3*	*Y*, % quality seeds
one	one	one	one	90.2
2	one	one	-one	92.91
3	one	-one	one	89.49
four	one	-one	-one	87.2
five	-one	one	one	88.3
6	-one	one	-one	92.16
7	-one	-one	one	89.4
8	-one	-one	-one	91.8
9	one	0	0	93.94
ten	-one	0	0	91.25
eleven	0	one	0	93.95
12	0	-one	0	91.58
thirteen	0	0	one	92.47
14	0	0	-one	94.83
15	0	0	0	97

The experimental results were processed by the MultipleRegression module of the Statistica 6.0 software.
After processing the results of a multivariate experiment on a PC, an adequate second-order mathematical model was obtained that describes the dependence Y = f (H, Vt, Pav) in encoded form:

$$Y = 96.16089 – 0.39900x1 + 0.80500x2 - 0.42200x3 - 2.10611x12 - 1.93611x22 - 1.05111x32 - 0.80750x1x2 - 0.73000x1x3 - 0.89500x2x3 \quad (1)$$

To study the response surface, two-dimensional sections were built (Figure 3).

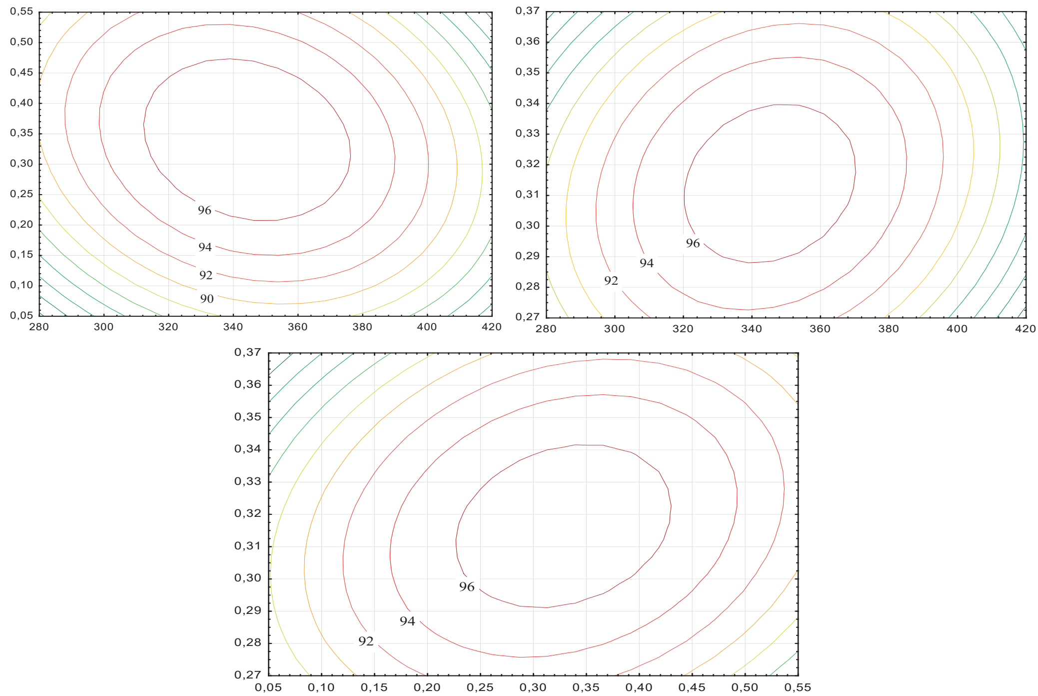

Figure 3. Two-dimensional sections of the dependence of the percentage of quality-treated seeds on the height of the nozzle installation, the speed of the conveyor and the pressure in the nozzle

Analysis of graphical images of two-dimensional sections shows that the highest value of seed dressing quality P = 96% of the total amount of seeds can be achieved with a nozzle installation height H = 320 ... 370 mm, conveyor speed Vt = 0.23 ... 0.43 m/s, pressure in the nozzle Pav = 0.29 ... 0.34 MPa.

CONCLUSIONS

There are many ways of pre-sowing seed preparation, but the purpose of all of them is the same - to increase the sowing and yield qualities of seeds. Seed dressing is an integral part of the technological process of growing crops, the need for which is beyond doubt. The proposed design of the plant for seed dressing will make it possible to achieve the value of seed dressing quality P = 96% of the total amount of seeds. The calculations of the technical and economic assessment show that the payback period will be 0.72 years. All this speaks about the economic feasibility of using a plant for seed treatment.

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