The results of determining the parameters of the shell device in experimental research

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Abstract. The article presents the optimal technological parameters of the device for increasing the quality indicators of the technological process of treating the seeds of agricultural crops with chemical drugs before planting or sowing, and coating the hairy seeds with low dispersion. According to it, when the shovel with a curved surface is installed 10-15° before the break point from the inner walls of the drum, taking into account the angle of friction of the seeds, the number of rotations of the shelling drum of the device is n=25...30 min-1, its angle of inclination relative to the horizontal axis It is stated that the goal can be achieved when β=40°.

1 Introduction

In the world, in order to prevent rotting in high humidity, resource-efficient technologies for increasing the spreadability of seeds by shelling and the devices that implement them are used for various diseases on the surface of seeds intended for grain sowing in the world, chemical drugs against ants in the ground, stimulants that have a positive effect on growth and productivity, and rotting in high humidity. scientific-research works aimed at the development of new scientific and technical foundations are being carried out [1, 2].

In this direction, among other things, development of new generations of energy and resource-saving shelling device and carrying out targeted scientific research on ensuring resource-saving in the process of formation of the shell layer on the upper layer of seeds without exceeding the norm in its technological work process is one of the urgent issues.

In order to achieve the result of evenly distributed chemical drugs on the surface of the seeds, stimulants that have a positive effect on growth and productivity, it is necessary to correctly choose the technological and structural dimensions of the shelling device, as well as work plans.

In particular, targeted scientific research was carried out to ensure resource-saving in the process of developing a shelling device and its technological work process in the process of

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forming a shell layer on the top of the seeds, and developed shelling devices with a shovel whose surface is curved and adjustable [3, 4].

In order to further improve the quality indicators of the technological process of processing the seeds of agricultural crops with chemical drugs before planting or sowing them and coating them with compounds that protect and nourish them, to increase the productivity of the device, to reduce the power it takes from the network, its technological and structural dimensions and operating modes are experimental found in studies [5].

2 Materials and methods

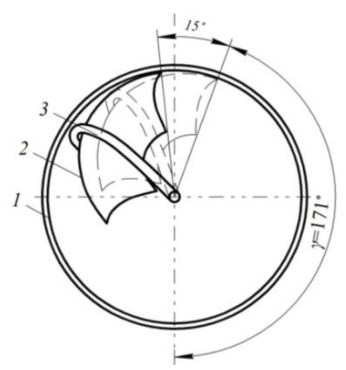
Experimental studies on determining the technological and structural dimensions and operating modes of the peeling device were carried out in the improved version of its pilot copy [6].

In experimental studies, the diameter of the drum, the number of rotations, the angle of installation of the shovel with a curved surface in relation to the vertical axis, the angle of inclination of the drum to the horizon, the mass of seeds loaded into the drum, the amount of glue and stimulant liquid sprinkled on the seeds, the time of spraying the glue and stimulant liquid, the mass of dry filler that evaporates , dry filler transfer time, dry filler mixing time, and process cycle times were investigated.

The diameter of the plate-shaped drum of the shelling device, the mass of seeds to be loaded into it, the amount of glue and stimulating liquid sprinkled on the seeds, the time it takes to sow them, the mass of the dry filler to be sprayed and the time it takes to transfer and spray it were adopted based on the results of previously performed scientific research [7].

Its values based on theoretical studies were used to determine the value of the angle of installation of a shovel with a curved surface in relation to the vertical axis.

Figure 1 shows the scheme of installation of the device in the direction of movement of the seeds in relation to the vertical for the complete and high-quality implementation of the technological process of processing the seeds of agricultural crops before planting or sowing and their shelling.



1 – plate-shaped drum; 2 - device; 3 – elbow

Fig. 1. The scheme of installation of a device with a curved surface relative to the vertical.

In order to disrupt the orderly movement of the seeds and to change their direction using their own speed, it is necessary to install the shovel on the inner wall of the drum 10-15° from the breaking point.

In the same way, using Figure 1, depending on the angles of friction of other seeds, it is possible to install the device in the direction of movement of the seeds in relation to the vertical, to carry out the technological process of high-quality treatment of them with chemical drugs and shelling with protective-nourishing compounds.

For example, about 100 kg of seed was loaded into the drum, and if it was spreadable like wheat seed, based on Figure 1, the shovel was set at an angle of g=108° in the direction of movement of the seeds with respect to the vertical axis, and experimental studies were conducted on the treatment of seeds with chemical drugs. If the spreadability of the seed loaded into the drum is low, i.e., about 100 kg of hairy seed is loaded into the drum, the guide shovel is installed in the direction of movement of the seeds at an angle of γ=171° in the direction of movement of the seeds in the manner described in Figure 2, and experimental studies were conducted on coating them with protective-nutritive compounds.

a) b)

Fig. 2. a) The appearance of the shovel's installation in relation to the horizontal axis. b) The view of the shovel inside the drum.

In each position of the shovel installed in relation to the vertical, experimental studies were conducted on the treatment of seeds with chemical drugs and their shelling. The movement of the seeds in the drum was photographed using a camera; the captured frames were analyzed and the installation angle of the device relative to the vertical was accepted.

3 Results and discussion

After determining the installation angle of the device relative to the vertical, 100 kg of hairy seed was loaded into the plate-shaped shelling drum of the device, and its number of revolutions was determined. For this, the number of rotations of the shelling drum is n=10; 15; 20; 25; 30; Hairy seed shelling experiments were carried out using asterisks between 35 and 40 min^{-1} at rotation steps of every 5 min^{-1}. As a criterion for evaluating the technological process, the degree of coating with compounds that protect and nourish seeds was accepted. The number of rotations of the drum was considered acceptable when the degree of shelling of the seeds reached the highest level.

Figure 3 shows a graph of the change in the degree of separation of the surface of the hairy seeds with the dry filling compound in the shelling device as a function of the number of rotations of the plate drum.

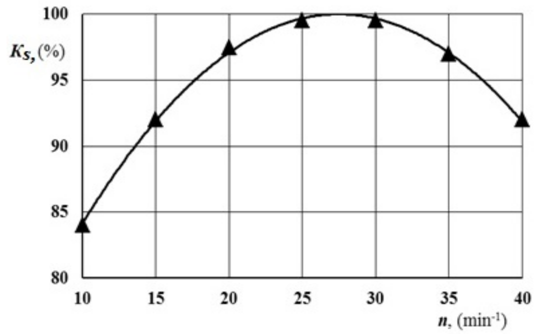


Fig. 3. Changes in the degree of clouding of hairy seeds (Ks) depending on the number of revolutions (n) of the shelling drum.

As can be seen from the curve shown in the figure, changing the number of revolutions of the drum of the shelling device leads to a change in the degree of misting of the surface of the hairy seeds with the dry filling compound. For example, if the number of rotations of the plate-shaped drum is equal to n=10 min^{-1}, the degree of fogging by the dry compound filling the surface of hairy seeds is K_s=84%, and when n=25 and 30 min^{-1} it is K_s=100% and s=92.5% when n=40 min^{-1}. In other words, the degree of misting of the surface of the hairy seeds with the dry filling compound increases up to a certain number of revolutions of the disk-shaped drum and then decreases. That is, when the number of revolutions of the drum of the shelling device is equal to n=25 and 30 min^{-1}, the degree of misting of the surface of hairy seeds with a dry filling compound reaches its maximum value. Increasing or decreasing the number of revolutions of the drum from these values will lead to a decrease in the degree of fogging.

The last situation can be explained as follows. When the number of revolutions of the drum is low, the hairy seeds slide on its surface, and when the number of revolutions increases, the hairy seeds are pressed against its walls under the influence of centrifugal force and do not actively participate in the technological process. Therefore, both conditions lead to a decrease in the degree of evaporation of the seeds by the dry filling compound.

From the analysis of the curve shown in Figure 3, the number of revolutions of the drum of the device should be around n=25...30 min^{-1} in order to ensure that the degree of fogging of the surface of the hairy seeds with the dry filling compound reaches a high value.

100 kg of hairy seeds were loaded into the drum to experimentally study the changes in the formation of a shell layer on the surface of the seeds depending on the time spent in the technological process. After that, experimental studies were carried out on coating the hairy seeds with compounds that protect and feed them, using a mechanism that changes the angle of the drum relative to the horizon, its angle of inclination relative to the horizon is set to 30°. The time required for the technological process was measured using a stopwatch. This stopwatch has an accuracy of ±1.0 s.

The formation of a permissible crust layer on the surface of hairy seeds was accepted as a criterion for evaluating the technological process. For this purpose, the thickness of the crust layer formed on the surface of hairy seeds was measured every 10 minutes using an electronic caliper.

Similar experimental studies were carried out with the drum set at an angle of inclination of 40° and 50° to the horizon.

Figure 4 shows the graph of the change in the formation of a crust layer on the surface of hairy seeds depending on the time taken for the technological process at different angles of inclination of the shelling drum to the horizon.

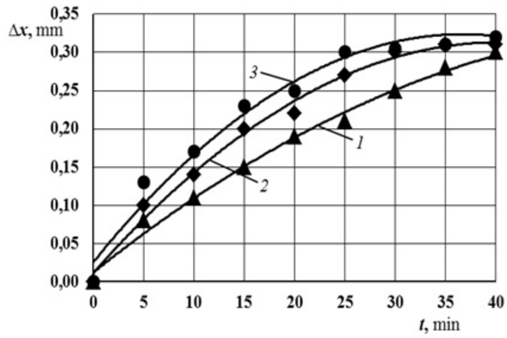


Fig. 4. Peeling drum with different slope angle (β) and technological shell layer (Δx) depending on the time taken for the process (t) change in formation 1, 2, and 3, respectively, at an angle of inclination of the shelling drum to the horizon of 30°, 40°, and 50°.

As can be seen from the graphs depicted in Figure 4, the thickness of the crust layer formed on the surface of the hairy seeds increased with the increase in the time taken for the technological process. At the same time, the slope angle of the drum relative to the horizon had a significant effect on the formation of the crust layer. For example, when the angle of inclination of the drum with respect to the horizontal plane is β = 30°, a layer of shell with Δx = 0.30 mm is allowed on the surface of hairy seeds, and the time required for the technological process is t = 40 minutes (Figure 4, Curve 1), when the angle of inclination of the drum with respect to the horizontal plane is b=50°, the permissible crust layer on the surface of hairy seeds is formed when the time required for the technological process is equal to t=27 minutes (Figure 4, curve 3).

In other words, with an increase in the angle of inclination of the drum relative to the horizontal plane, less time is spent on the formation of a permissible crust layer on the surface of hairy seeds.

As can be seen from Figure 3.7, if we take into account that 25-35 minutes are spent on the technological process for the formation of a high-quality and evenly distributed crust layer on the surface of hairy seeds, the permissible crust layer is achieved when the angle of inclination of the drum to the horizontal plane is β =40° (Figure 4, curve 2).

In order to determine the change of the degree of seed turbidity depending on the angle of inclination of the shelling drum with respect to the horizon, 100 kg of hairy seed was loaded into it and experimental studies were carried out. For this, the angle of inclination of the drum relative to the horizon was changed from 20° to 70° using a mechanism that changes the angle of inclination of the drum relative to the horizon in 10° intervals. Experimental studies were carried out on coating hairy seeds with protective-nutritive compounds at different angles of inclination of the drum to the horizon. At the highest level, the angle of inclination of the drum relative to the horizontal plane was considered acceptable.

As a criterion for evaluating the technological process, the degree of contamination with compounds that protect and nourish hairy seeds was taken.

Figure 5 depicts a graph of the change in the degree of misting with compounds that protect and feed hairy seeds depending on the angle of inclination of the shelling drum with respect to the horizontal plane.

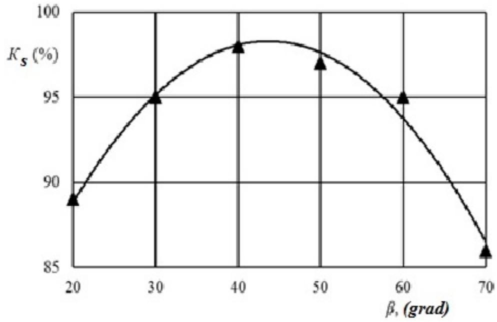


Fig. 5. Variation of the degree of cloudiness (Ks) depending on the angle of inclination (β) of the peeling drum to the horizontal plane.

As can be seen from the curve depicted in Figure 5, with the change of the angle of inclination of the drum relative to the horizontal plane, the degree of clouding of hairy seeds also changes, that is, it first increases and then decreases again. For example, when the angle of inclination of the drum with respect to the horizontal plane is equal to β=20°, the degree of clouding of hairy seeds is K_s=88.0%, when it is equal to b=40°, it is K_s=98.0%, b =60°, K_s=95.0%, i.e. it changes according to the law of parabola.

4 Conclusion

The last situation can be explained as follows. When the angle of inclination of the drum with respect to the horizontal plane is small, all hairy seeds do not move with it, but some of them slide. Therefore, when the angle of inclination of the drum with respect to the horizon is small, the degree of misting of hairy seeds is reduced. At a certain angle of inclination of the drum relative to the horizontal plane, since all the seeds participate in the technological process and move together with the drum and around its axis, their degree of evaporation is high. As the angle of inclination of the drum relative to the horizontal plane increases, the hairy seeds move along with the drum and its movement around its axis decreases. Therefore, an increase in the angle of inclination of the drum relative to the horizontal plane leads to a decrease in the level of misting of hairy seeds.

So, based on the results of the experimental studies on determining the variation of the permissible shell layer formation depending on the time spent in the technological process of shelling with compounds that protect and feed hairy seeds, the angle of inclination of the drum relative to the horizontal plane is equal to β=40°, the number of revolutions is n=25... When it is around 30 min^{-1}, it turns out that the time required for the technological process is t=40 minutes.

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