

Dmutro Derevjnko,

*Zhytomyr National Agroecological University,
Associate Professor, Ph.D. in Agricultural Sciences,
Engineering and Energy Faculty,*

Elena Sukmaniuk,

*Zhytomyr National Agroecological University,
Senior Lecturer, Ph.D. in Historical Sciences,
Engineering and Energy Faculty,*

Oleksii Derevjnko,

*Zhytomyr National Agroecological University,
Student, Engineering and Energy Faculty*

Caryopsides injury and drying modes while seed preparing

Abstract: The process begins with the lower seed layer drying, that receives heated air, which quickly saturated with moisture from caryopsides layer thus dried seeds.

The higher seeds layers are, the less they can be dried them that will be the main uneven quality cause over time and can cause cracking, injury and quality worsening.

The optimal and correct mode for drying seeds of various crops setting is a top factor in high-quality seeds obtaining, especially of high energy and similarities.

Keywords: seeds, profiles, injury, quality, moisture.

Introduction. We know that winter wheat, rye and the other very important valuable crops occupy sowing large areas and play an important role especially in food safety, that's why there is an urgent seeds high-quality need.

For many decades, especially in the second half of the previous century scientists, researchers, breeders and manufacturers proved and substantiated that only high-quality seed for all other equal opportunities provides formation of the future harvest large part.

In addition, the important fact is that there is to some extent lag in improvement, manufacturing and introduction of new harvesting, post-harvest grain techniques and technologies, preparing, transporting, loading, seed treatment and sowing.

Research shows that improving of the working elements influence of technical means during manufacturing processes on reducing caryopsides injury contributes significantly to improving quality indicators of seed and growth crop capacity.

The recent research analysis. Injury, damage and complete caryopsides destruction is a consequence of mechanical stress of the harvesting to sowing process.

I. Strontium, D. Derevianko, O. Tarasenko, V. Orobinskii, P. Puhachov, S. Chazov, L. Fadeyev [3, 2, 4, 8, 9] and others researches show that the caryopsides injury during threshing reaches 20% or more, while improving grain, seeds preparing and planting increases significantly, sometimes reaches 60-80%.

According to V. M. Drinch [5] caryopsides injury while threshing sometimes reaches 30-35%, and while the seeds preparing even 50%, depending on humidity and grain structure.

In recent years significant work was performed by L. Fadyeyev [7] on the development and introduction in manufacture of essentially new cleaning-calibration means and technical lines.

In scientific bases creating of interference mechanisms and working surfaces of various materials theory foundation, including grain mass, a significant contribution was made by such prominent scholars as P. Vasilenko, L. Pohorilyy, V. Dryncha, V. Adamchuk, L. Tischenko, O. Tarasenko, P. Zayika, I. Strona, E. Goncharov [1; 2; 3; 5; 6] and others.

A deep and comprehensive study of the physical and mechanical and biological seeds characteristics and development of new technologies and work modernization that will provide the minimum number of caryopsides injury is the basis to obtain high-quality seeds.

Experimental methods. The method of mathematical modeling of machines, work items and processes was used.

Computational differential equations, conversion and image definition on the basis of the mechanics laws were applied.

Experimental, industrial and laboratory studies were conducted under production conditions of different soil and climatic zones and government laboratories seed plants, bakery and higher educational institutions using specimens, technical equipment, instruments and tools in accordance with existing state standard methods.

Results and discussion. While seeds of various crops drying, we have the processes of transportation and loading screw, scraper, belt conveyors or other technical means that leads to the caryopsides injury and reduce their quality.

In the performance process technology with inclined screw conveyor or vertical placement such factors as the angle of the spiral screw force pressing seeds to the body, the critical frequency speed screw and others influence on seeds injury.

Essentially physical characteristics of seeds moving in orbits during rotation of the screw follows that with increasing elevation angle of the spiral increases the seeds movement resistance (Fig. 1).

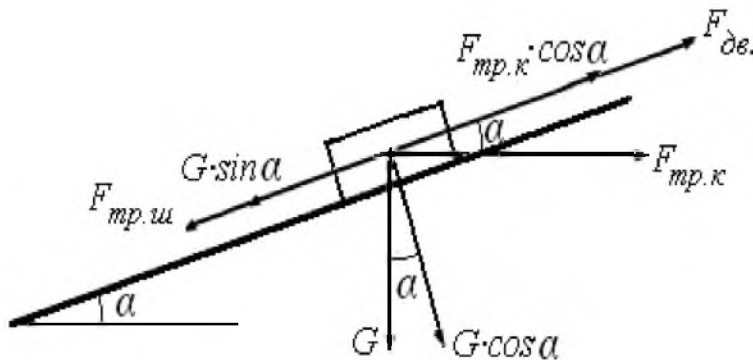


Fig. 1. Scheme of the force on grains while moving along turns of the screw

According to this forces scheme acting on a number of seeds between turns along the screw (Fig. 1) we see, that force that promotes seeds movement up screw turns is friction with the F_{tk} casing and counteract this friction force of the F_{th} screw turns and gravity, so the difference between the first and the sum of two others allows to define the force that moves the seeds turns screw up:

$$F_p = m \cdot [\omega_u^2 R \cos \alpha \cdot f_k - g(\sin \alpha + \cos \alpha \cdot f_u)], \quad (1)$$

Where ω_u, R - the angular velocity and the screw radius;

α - the uplift angle of the screw turn;

f_k, f_u - the friction coefficient of seeds with casing and auger.

The analysis of motion intensity force depending on the uplift angle turn shows that this figure is variable and the lowest intensity is in the range $\alpha = 5 - 10^\circ$, and starting with $\alpha = 15^\circ$, the intensity increases proportionally to the uplifting angle of the screw turns.

To provide maximum productivity and minimum seeds injury the uplift angle of the screw must be at least 15 °.

Grain drying with active ventilation in a stationary layer is a universal method suitable for processing of any culture grain heap for different uses.

Due to threshing grains that falls on the threshing floor at presence of insufficiently mature seeds are ventilated to speed up the ripening process and increase vigor and similarities, and when stored it must be fulfilled to preserve the viability of the seed.

Drying of the grain mass in a stationary layer is done on floor and rhombic dryer in the bunkers of active ventilation in chamber dryers.

Under different seed moisture we dry it for a single period, without unnecessary moving and additional injury, besides drying without cleaning grain is possible too. Drying process begins first in place air inflow in the grain layer, in its lower part. We have the quick process of air moisture saturation, that it takes from grains and lower layers are dried out first.

Due to the fact that the layer of grain is dried latter essentially determines the duration of drying, and a part of grain mass, dry still useless ventilated so air is used inefficiently and there is some seeds over drying.

Increasing of warm air flow leads to drying intensification, rapid removal of moisture from the common layer of the grain mass.

If the air is saturated with a high relative humidity, there is a need for its heating by several degrees.

Drying the grain layer of a small height is provided by heated outside air with bringing coolant temperature to 30 - 35 °C. Further increase of temperature can be dangerous because it can cause cracks. So, for obtaining high-quality seeds it's unacceptable caryopsides cracks receiving, and thus overheating during drying cannot be achieved with maintaining the required temperature parameters of air. Maximum permissible temperature of heating air with active ventilation is listed in Table1.

Table 1. Maximum allowable temperature during seed drying

Plant	The temperature at seed moisture %	
	18	24
Winter wheat and spring	46	42
winter rye	51	47

This temperature conditions, combined with the normal air consumption to the 1000 - 1500 m³/h. per ton of grain at the layer thickness of 0,6 - 0,8 meters for cereals, 0,5 - 0,6 m - for legumes and 0,3 - 0,5 m - for corn should be the foundation of dried seed technology by active ventilation. These parameters are confirmed as the best while using them for industrial processing lines. This process should be carefully observed according to the time and data devices.

Heated air supplying is stopped when reaching average seed moisture 12 - 14%, in this case the moisture of the upper layer, which is dried up 16 - 18% lower – 10 - 12%.

Further ventilation of the grain mass layer is not heated by atmospheric air for its cooling will promote some alignment of upper and lower layers moisture.

For rapid setting the desired drying mode you should know that under normal weather conditions, heating the air at 1 °C reduces the relative humidity within 5%, but together with the positive impact has negative consequences, because the caryopsides overheating leads to injury them due to cracking.

Preventing seeds injury will allow to use the active ventilation or natural atmospheric heated by several degrees air without moving grain mass. Drying at a higher temperature, as previously mentioned when analyzing increases the difference of the upper and lower parts of the grain mass, dried, resulting in a risk of overheating that is caryopsides overheating and their cracking-seeds injury at the start of the operation or quality deterioration due to water logging at the end of the operation.

In carrying the active venting it must be considered that the length of drying is limited due to worsening of seeds quality in the most distant from air seat of the grain mass.

Conclusions

To obtain high-quality seeds it is necessary to achieve evenly drying layers of seeds mass during the entire process.

Violation of this requirement will contribute to the formation of cracks, degradation and deterioration of quality indicators. Speed screw, pressing to the body and the angle of the screw helix also affect the seeds injury.

To set the optimal drying modes, you must correctly identify the seeds layer height, speed, income and temperature and the appropriate amount of seeds by time period.

While using special drying mode, even longer in time, at lower seed moisture less than 6%, especially the similarities negatively affect the quality of seeds.

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