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EXPERIMENTAL RESULTS OF ELECTRICALLY CLASSIFIED MELON SEEDS

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Abstract
This article presents the results of sorting melon seeds using an electrical sorting device, including the voltage values applied to the electrodes and the names of the fractions, the quantity of separation into fractions, as well as the results of studying the mass of 1,000 seeds.

Keywords: Electrical sorter, melon seeds, electric field, laboratory prototype, sorting, fractions, technical fractions, bunker, high-voltage power supply, reducer, LATR, frame.

Introduction

It is well known that in obtaining high yields from agricultural crops, including melon crops such as melon, along with other agrotechnical measures, the quality indicators of seeds prepared for sowing play an important role. This is because the use of high-quality selected seeds with similar biological properties, high laboratory and field germination capacity, and high potential productivity is considered a guarantee of abundant yield [1–13].
It is known from scientific sources that in order to obtain high-quality seeds with similar biological properties, high laboratory and field germination, and high potential yield, it is necessary to sort them according to all significant physical and mechanical properties [14]. This requirement is fully met by sorting agricultural crop seeds in an electric field. The reason is that the electric field

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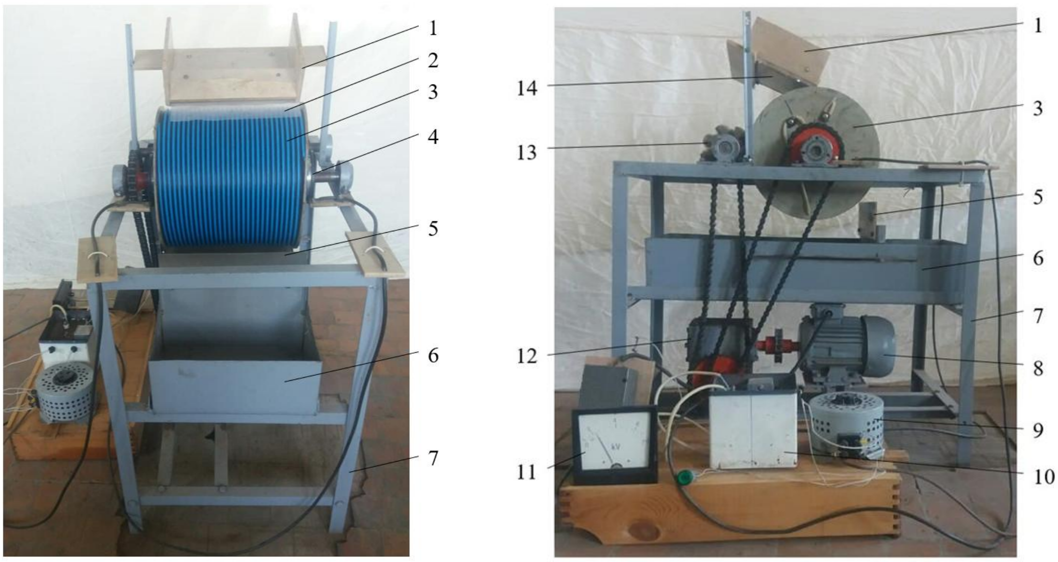
affects the seeds by means of a directed electric field force, taking into account all their important physical and mechanical properties [15]. As a result, seeds are sorted in the electric field according to all essential physical and mechanical characteristics, namely mass, geometric dimensions, dielectric permittivity, and other similar important properties.

Taking this into account, as a result of scientific research carried out in recent years at the Research Institute of Agricultural Mechanization, an electrical sorting device for sorting melon seeds was developed.

Experimental studies on melon seed sorting were conducted in four repetitions using the laboratory prototype of the developed electrical sorting device.

In order to verify the technological operating process of the electrical sorting device developed for melon seed sorting, its laboratory prototype was manufactured. The figure shows the general view of the laboratory prototype of the electrical sorting device developed for sorting melon seeds.

The device consists of a loading hopper (1), a guiding mechanism (2), a working unit (3), a current conductor (4), a separation plane (5), a receiving hopper (6), a frame (7), an electric motor (8), a LATR (9), a high-voltage power supply (10), a kilovoltmeter (11), a reducer (12), a brush (13), and a sliding board (14).



a) b)

Figure. General view of the laboratory prototype of the electrical sorting device: a) front view; b) side view

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1 – loading hopper; 2 – guiding mechanism; 3 – working unit; 4 – current conductor; 5 – separation plane; 6 – receiving hopper; 7 – frame; 8 – electric motor; 9 – LATR; 10 – high-voltage power supply; 11 – kilovoltmeter; 12 – reducer; 13 – brush; 14 – sliding board.

The working unit (3) is made of a polyethylene pipe, on the surface of which four helical grooves are machined with a groove angle of 60° and a width of 5 mm. Between the grooves, oppositely charged electrodes with a diameter of 5 mm are wound in a single row. The oppositely charged electrodes are connected to the high-voltage power supply (10) via current conductors (4).

The operating principle of the device is as follows. The device is connected to the power supply, and depending on the physical and mechanical properties of the melon seeds to be sorted, high voltage is applied to the oppositely charged electrodes via the LATR (9) and the power supply (10). After that, the start button is pressed, and by means of the electric motor (8) and the reducer (12), the working unit (3) and the brush (13) are set into rotational motion through chain transmissions. At the same time, the melon seeds to be sorted are uniformly supplied from the loading hopper (1) to the surface of the working unit (3) through the sliding board (14). The seeds delivered to the surface of the working unit (3) are placed into the grooves between the oppositely charged electrodes and, under the influence of the electric field formed between them, become polarized and are attracted by the resulting electric field force. In addition to the electric field force, the seeds are also subjected to centrifugal force, gravity, inertia, reaction, and friction forces. Based on the ratio of the acting forces, the melon seeds, depending on their physical and mechanical properties, detach from the surface of the working unit (3) at different angles and fall into the corresponding fraction of the receiving hopper (6), namely the seed or technical fraction. Seeds adhering to the surface of the working unit (3) are removed by means of the brush (13).

By changing the voltage value applied to the electrodes with opposite charges, various melon seeds can be sorted in the proposed device. Experimental studies on melon seed sorting were conducted to test the technological process of the proposed device. The experiments were carried out using melon seeds of the "Obi novvot" variety. Here, with a working body diameter of 310 mm, a rotation speed

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of 40 min^{-1}, opposite-charge electrode diameter of 5 mm, and a distance between them of 5 mm, voltages of 2250, 2500, and 2750 V were applied to the electrodes. The degree of separation of seeds into fractions and the mass of 1000 seeds were adopted as criteria for evaluating the technological sorting process. The results of the melon seed sorting are presented in the table.

Table

Results of Melon Seed Sorting

No	Voltage applied to electrodes and fraction names	Fraction separation amount, %	Mass of 1000 seeds, g	Difference	
				g	%
1	U=2250 V Initial seed After sorting: - Seed fraction - Technical fraction	 100,0 95,45 4,55	 71,83 72,10 66,17	 – +0,27 –5,66	 – +0,38 –7,88
2	U=2500 V Initial seed After sorting: - Seed fraction - Technical fraction	 100,0 86,7 13,3	 71,83 72,33 67,38	 – +0,50 –4,45	 – +0,70 –6,20
3	U=2750 V Initial seed After sorting: - Seed fraction - Technical fraction	 100,0 80,9 19,1	 71,83 72,60 68,40	 – +0,77 –3,43	 – +1,07 –4,78

As can be seen from the results presented in the table, when a voltage of 2250 V was applied to the electrodes with opposite charges, 95.45% of the melon seeds were separated into the seed fraction, and the mass of 1000 seeds increased by 0.27 grams or 0.38% compared to the initial seed mass. Conversely, the opposite was observed in the technical fraction, i.e., the mass of the 4.55% of melon seeds separated into the technical fraction decreased by 5.66 grams or 7.88% compared to the control.

When the voltage applied to the electrodes increased to 2500 V, the mass of 1000 melon seeds separated into the seed fraction, constituting 86.7%, equaled 72.33 grams. This represents an increase of 0.50 grams or 0.70% compared to the initial melon seed mass. The mass of 1000 melon seeds separated into the technical fraction, constituting 13.3%, decreased by 4.45 grams or 6.20% compared to the

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initial melon seed mass.

When the voltage applied to the electrodes reached 2750 V, the mass of 1000 melon seeds separated into the seed fraction, constituting 80.9%, equaled 72.6 grams. This represents an increase of 0.77 grams or 1.07% compared to the initial melon seed mass. Conversely, the mass of 1000 melon seeds separated into the technical fraction, constituting 19.1%, decreased by 3.43 grams or 4.78% compared to the initial melon seed mass.

Analysis of the results presented in the table shows that as the voltage applied to the electrodes with opposite charges increases, a consistent general trend is observed: the quantity of melon seeds separated into the seed fraction decreases, while the quantity separated into the technical fraction increases. This is because an increase in the applied voltage to the oppositely charged electrodes leads to an increase in the strength of the electric field, which in turn exerts a greater attractive force on the melon seeds towards the surface of the working body. Consequently, with higher applied voltage, the melon seeds are pulled with greater electric field force towards the working body surface and consequently transfer into the technical fraction.

A different pattern is observed in the mass of 1000 seeds: as the voltage applied to the electrodes increases, the mass per 1000 seeds for both the seed and technical fractions also increases. The reason for this is that with higher applied voltage, the seeds are attracted to the working body surface with greater force, causing even relatively larger and heavier seeds to become mixed into the technical fraction.

Thus, in the proposed electrical sorting device, by adjusting the voltage applied to the electrodes with opposite charges, it is possible to alter both the separation quantity of melon seeds into fractions and the mass of 1000 seeds.

Conclusion. By increasing the voltage applied to the electrodes, it is possible to control the separation quantity of melon seeds into seed and technical fractions, adjust the mass of 1000 seeds, and manage the technological process in the proposed electrical device. This allows for sorting melon seeds in the proposed device and obtaining high-quality seed material.

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