Investigation of starting tension of alfalfa and bitter cane seeds in the interelectrode space of electric cleaner

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ABSTRACT

Based on the basic properties of alfalfa seeds, the article substantiates the constructive scheme of their cleaning from seeds of quarantine plants. For sorting and cleaning of alfalfa seeds the constructive scheme consisting of concentric cylindrical electrodes with increasing intensity of electric field in the direction of seed movement has been adopted.

Keywords: Alfalfa, weed plants, seeds, properties, cleaning.

I. Introduction

Food security of Uzbekistan can be solved primarily through the preparation of high quality alfalfa seeds. The total area under alfalfa in the Republic of Uzbekistan in recent years varies in the range of 90 thousand hectares, for the preservation of which, based on the calculation of 5-year herbage, about 270 tons of seeds need to be prepared annually [1].

The average yield of alfalfa seed on irrigation remains at a rather low level (about 1.5 c/ha) due to low agricultural practices of cultivation, weed infestation of the fields, lack of special technical means for cleaning, sorting and conditioning the seed material in farms.

To eliminate these shortcomings we analyzed the current state of technical means of seed preparation of alfalfa [2]. The existing technology of cleaning seed provides the use of a complex of machines composed of thresher-weaver MV-2,5A, cleaner of pile seed OVS-28, cracker K-0,5A, cleaner Petkus-Selektra, trier BT-20, pneumosorting table PSS-2,5 and electromagnetic cleaner EMC-1A. Large metal and power consumption, significant cost of manual labor and capital investments hamper the use of this seed cleaning complex in terms of seed farms.

The principle of operation of electromagnetic seed cleaning machine EMS-1A designed for final cleaning of alfalfa seeds from difficult to separate weed seeds (dodder, humus, couch grass, bitterroot etc.) is based on the ability of weed seeds to be enveloped by a special magnetic powder (trifolin), which is harmful to the environment and humans. In addition, the seed material should be well dried and undergo preliminary preparation consisting of 15 and more operations before passing through [3].

Therefore, to improve the quality of seed material, the simplest and most effective way is the application of electric field forces [2]. However, the use of triboelectric [1] and dielectric devices did not help to achieve purification of alfalfa seeds from seeds of quarantine plants to the level of their requirements [4].

Studies [5] have shown that the average length of alfalfa and mustard seeds are 1.85 and 2.87 mm, i.e., mustard seeds are 1 mm longer than alfalfa seeds. To a lesser extent, they differ in thickness, which is, respectively, 0.85 and 1.05 mm, and their distribution curves overlap each other to the greatest extent. The widths of the same seeds are 1.58 and 1.97 mm, and the sphericity coefficients average 0.657 and 0.426. This shows that mustard seeds start to the upper electrode at lower electric field strengths than alfalfa seeds. The use of electrostatic separators with divergent flat electrodes, in which the field strength and the value of the acquired charge are increasing, create good opportunities to change the trajectories of alfalfa and mustard seeds during their movement to the upper electrode after detachment from the potential lower electrode [6].

The purpose of the present work is to experimentally investigate the distribution of alfalfa and mustard seeds in an electrostatic field

II. Research Methodology

Starting or detachment strength is the field strength at which grains on the electrode, having received a contact charge and overcoming gravity, are detached from the lower electrode upwards. The starting field strength depends on dielectric permittivity, electrical resistance, shape, size, density of the seeds, as well as the time of their location and position on the electrode [7]. To determine Est we used a laboratory setup consisting of electrodes set one above the other and insulated with a conveyor belt from the inside. High voltage, monitored with a C-100 kilovoltmeter, was fed to the lower potential electrode from a high-voltage converter PVS-40.

Calculations show that the seeds under study, lying on the contact electrode for 1 s, acquire a charge close to the limit. Necessary time for charging the seeds was carried out by applying voltage to the potential electrode. When the "Start" button on the PVS-40 control unit was pressed, the time relay was switched on and simultaneously the high voltage was applied.

Alfalfa and mustard seeds, selected 100 pcs by random sampling, were placed in one layer on the fixed grounded electrode. Using a C-100 kilovoltmeter, the minimum voltage (determined experimentally) necessary to start the seeds was set. Then high voltage was applied. The experiment was continued at a voltage interval of 1 kV until the grains of the main crop and its clogger were completely lifted. During the whole experiment the interelectrode distance and time of high voltage application were unchanged. Humidity and air temperature were controlled and were equal to 73 % and 21 C0, respectively. Each grain from the interelectrode spacing was weighed on a BT-500 torsion scales and placed in a pencil case.

III. Results And Discussion

The results of studies of differential and integral distributions of alfalfa and bittercane seeds by starting electric field strength are shown in Fig. 1.

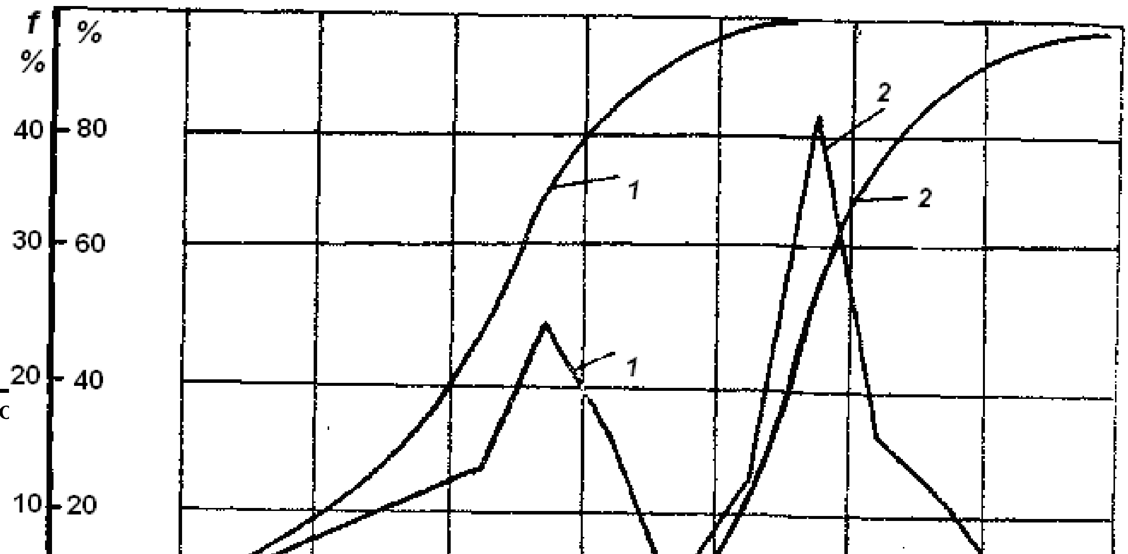

Figure 1. Differential and integral curves of distribution
of seeds of alfalfa (2) and bitterling (1) by starting tension

Seeds of alfalfa are detached from the lower potential electrode at lower voltages than seeds of quarantine plant of bitterling. Thus the detachment of mustard seeds occurs at electrostatic field strength in the range of 2,0 ... 5,75 kV/cm, whereas the detachment of alfalfa seeds occurs at strength range of 5,25 ... 7,0 kV/cm. At these lower voltages small and light seeds come off, and at higher voltages heavier and larger seeds come off.

Technologically, the initial seed to be cleaned must be fed to the surface of the lower potential electrode at a lower voltage point with movement in the direction of the higher voltage. Integral and differential curves of seed distribution according to the starting tension show that it is possible to separate mustard seeds from the main crop sowing material if the seed humidity is 8%.

IV. Conclusion

1.Known technical means do not provide the required purity of alfalfa seeds because of their inherent flaws that do not take into account their morphological structure features.

2. To increase the accuracy of cleaning, it is necessary to use a device with flat electrodes that form a non-uniform electrostatic field, the strength of which increases linearly in the direction of seed movement.

3. Differential and integral curves of lucerne and bittercane seeds distribution according to the starting tension show that their distribution curves have the minimum overlap zone at significantly lower tensions for lucerne seeds than for bittercane seeds. This may serve as an important feature for their separation in the electric field.

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