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MECHANICAL SEPARATION OF SEEDS

Economic aspects of nursery production require seeds of high genetics quality and high germination ability. Thanks to the separation process, full and well developed seeds are separated from empty and damaged ones. Nevertheless, this process cannot cause loss of lighter seeds (the presently used separation methods often lead to such results), as owing to the genetics variability, big and heavy seeds are as important as small and light ones. Aiming at the optimisation of the seeds mechanical separation process, from among many distinguishing features such a feature should be chosen that for the given seed lot, secures the shortest technological line for carrying out cleaning and grading. The paper presents designs of two separators for forest tree seeds that were made in Department of Forest Work Mechanisation of Agricultural University of Cracow: pneumatic separator with a vertical air channel and column for separation of seeds, based on the difference in their elasticity.

Keywords: forest tree seeds, separation properties, sorting process

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Механічне відділення насіння

Економічні аспекти лісовідновлення вимагають насіння високої генетичної якості і доброї здатності проростання. Завдяки процесу відділення, повні і добре розвинуті зерна відокремлюються від порожніх і пошкоджених. Проте, цей процес може викликати втрату більш легких зерен (методи відділення, що тепер використовуються, часто приводять до таких результатів), як наслідок, до мінливості генетичних властивостей. Великі і важкі зерна такі ж важливі, як і малі та легкі. Напрямок оптимізації механічного процесу відділення зерен повинен бути вибраний так, щоб забезпечити найшвидше і найякісніше очищення та сортування насіння. В статті представлено два роздільники насіння лісових дерев, які розроблені на кафедрі механізації лісових робіт Аграрного ун-ту Кракова: пневматичний роздільник з вертикальним повітряним каналом і колона для відділення зерен, принцип дії яких базується на різниці еластичності насіння.

Ключові слова: насіння лісових дерев, властивості розділення, процес сортування

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Introduction

At the present times larger and larger significance acquires taking advantage of full germination capacity of seeds, and using them for artificial growing of maximum number of seedlings. At the strict regionalization, and seed production from limited number of choice trees, seed stands and plantation production, the number of seedlings grown from limited amount of seeds should be as high as possible, as the afforestation and forest regeneration tasks keep growing [4].

Economic reasons of nursery production require seeds of high genetic quality and high germination ability. That's why for storage of seeds, reserves for years of crop failure, long-term storage to preserve gene pool (Forest Banks of Gene) and secure adaptation and sowing, seeds of the best quality should be used. It will result in decreasing of overall costs of the seedlings production and additionally will secure better utilization of the production area. In view of the above mentioned, seeds separation can be considered as an important issue [6, 9].

Thanks to separation process, full seeds and well-developed are separated from empty and damaged ones. Nevertheless, this process cannot cause loss of lighter seeds, which often happens when using current separation methods. It must be remembered that trees of the same species produce seeds of different size. Old trees and stands often produce smaller seeds than the younger trees that start seed bearing. With regard to genetics variability protection, big and heavy seeds are as important as small and light ones. Eliminating smaller and lighter seeds means discarding yield of those trees that are best adapted to the given site conditions [5, 8]. Moreover, seeds for a purpose of long-term storage e.g. in Forest Bank of Gene in Kostrzyca, or in regional gene banks, should exhibit full genetic diversity of the represented ecosystem [10].

Velocity of suspension and the seeds elasticity

The seed segregation to quality classes is done with device working on the basis of distinguishing physical features of seeds. Some features are closely correlated with biological properties. Obtaining selected seeds requires good knowledge of the seeds agrophysics and principles of separation processes. Aiming at optimisation of the seeds mechanical separation process, from among many distinguishing features such a feature should be chosen that for the given seed lot secures the shortest technological line for carrying out cleaning and grading [3]. So, it is worthwhile to consider separating features that so far were not used in forestry, but, according to the results of technical evaluation of potential grading devices, they should be taken into consideration in design of prospective universal grading machines [2].

Aerodynamic properties of seeds are best characterized by critical velocity, defined as velocity of air flow that keeps the seed in the state of suspension, as a result of achieving equilibrium between weight of seed and intensity of air flow [3]. Pneumatic devices can be successfully used in forest tree seeds separation process, as they are characterized by many advantages:

- simultaneous cleaning and sorting is possible,
- seeds are not damaged,
- physical and biological properties of seeds are not changed,

- stepless regulation of separation parameters is possible,
- they are characterized by high efficiency at small dimension and low energy consumption,
- emission of noise is low,
- they do not cause dustiness (in the case of aspirators).

In the separation technique of granular materials only some of their numerous mechanical properties are used as distinguishing features. The seed elasticity is numbered among basic and most frequently used separation properties. Mechanically, seeds partly resemble elastic bodies, which means that after temporary deformation they are able to return to their original shape. In separation process based on this property, difference between elastic properties at collision distinguishes behaviour of separated components.

In practice, value of coefficient of kinetics energy restitution for each single seed is determined in such a way that the height of its rebound from horizontal plane is measured, after its fall from the constant height [1]. The height of rebound, i.e. the value of coefficient of restitution, depends in considerable degree on air resistance, irregular shape, anisotropy and moisture content of the seed. It was stated that with the seed higher moisture, the value of coefficient decreases, which means that the seed is liable to plastic deformation. The height of rebound is a measure of potential energy, but also a measure of kinetics energy, if not considering the losses caused by aerodynamic resistance.

Separators of forest tree seeds

In the Department of Forest Work Mechanisation of Agricultural University of Cracow a pneumatic separator with a vertical duct was designed (Figure 1). The construction and work principle resemble the existing Scandinavian separators [7], nevertheless, by the Polish Patent Office it was accepted as invention, under the following name: "Pneumatic separator for granular materials, especially for forest tree seeds" (Patent no 353630). Object of the invention is a vacuum pneumatic separator, appropriate for segregation of the dosed material into three fractions, dependent on the mass of gravitationally falling particles in the flow of sucked air.

Separator consists of a stand-mounted separation column, container for collecting fractions, ventilation system made of pipes connecting separation column with suction fan and intake. Vertical separation through-duct is situated in the column symmetry axis; two sedimentary chambers of the same volume, having suction inlets in the separation duct, are placed on both sides. After each inlet of the sedimentary chambers, there are downward directed partitions that cause decrease of air flow velocity, which results in falling of the fraction on the chambers bottom. In the outer wall of the separation column access eyes are made for installation of anemometers. Separation column has a transparent front wall, which enables visual observation of cleaning and grading. The intake unit consists of vibratory feeder, funnel build above the intake opening and charging hopper, placed tightly in chute cover. The vibratory feeder consists of chute, electromagnetic coil and regulator controlling steplessly the vibration amplitude. On the side of the separation column a stepless thyristor revolution regulator of the fan is mounted. It is designed to control steplessly the velocity of the air flow in given zones of the duct [11].

Separator functions in such a way that seeds from the charging hopper fall first on the chute of the vibration feeder, then further gravitationally to the chute chamber. Seeds in the separation duct fall opposite to the direction of the main airflow sucked in from the bottom. During falling, seeds are snatched by suction stream of the bottom inlet mouthpiece, where medium size fraction is separated. The heaviest fraction of healthy seeds, falls into container.

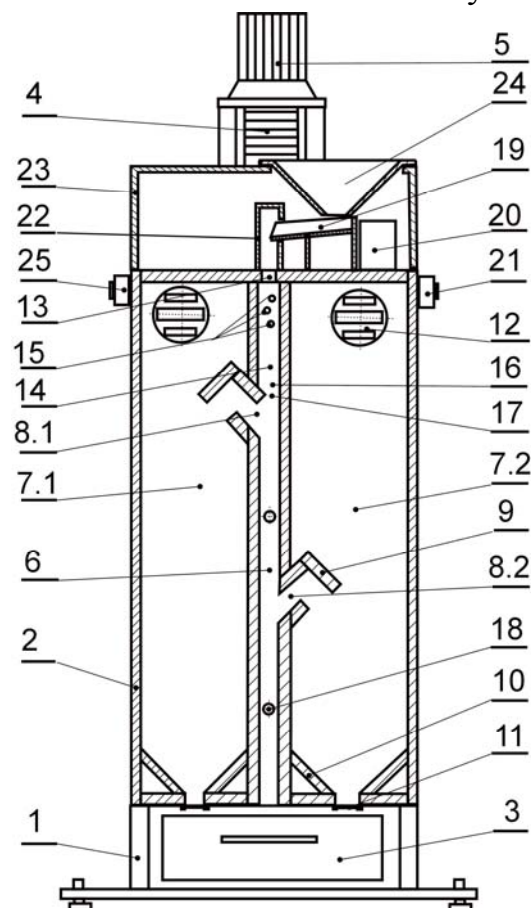


Figure 1. Scheme of the pneumatic separator:

- 1 – frame base, 2 – separation column, 3 – container, 4 – ventilation pipe, 5 – suction fan, 6 – separation duct, 7 – sedimentary chamber, 8 – inlet mouthpiece, 9 – partition, 10 – chute funnel, 11 – ward, 12 – outlet opening grate, 13 – intake opening, 14 – chute chamber, 15 – beating rods, 16 – confusor, 17 – outlet nozzle, 18 – access eye, 19 – chute, 20 – electromagnetic coil, 21 – coil regulator, 22 – funnel, 23 – chute cover, 24 – charging hopper, 25 – thyristor regulator of fan

Operation principle of another separator, designed in the above-mentioned Department, is entirely based on distinction of elasticity [12]. It was registered in the Polish Patent Office as: "Column for granular materials, especially for forest tree seeds" (number P-353630).

The invention object is shown on Figure 2. Separation column consists of frame, separation box with transparent front wall, two replaceable containers for obtained fractions placed under release funnels and charging system.

The last one includes charging hopper and vibrating feeder that comprises chute and electromagnetic coil. The box is divided into two vertical ducts (grading and shooting) with vertically displacing shutter wall, constituting a system of fraction partitions. In the grading duct there are systems of reversibly inclined plates, build in a form of cascades. Cascades constitute a staggered falling trajectory of the particles.

Each set includes the rebounding elastic plate, situated higher in the axis of the inlet opening, and lower placed reversible skidding plate. Rebounding plate can be slid out of the separation box side, and it is inclined to the horizontal level by 22.5° angle. Reversible plate is fixed in the middle of the separation box and acts as guide bar for co-acting fraction partition.

Principle of operation is following. Seeds from the charging hopper fall on the vibrating feeder chute, and then, further gravitationally into the inlet opening. On their way, seeds knock the rebounding plate. Depending on rebounding energy, seeds pass over the fraction partition to the chute, fall into the container if they are healthy material, or, they stop at the partition, fall down on the inclined plane of the reversible plate, and slide to the reversible plate of the second degree, where the above-described cycle of kinetics grading is repeated.

Undeveloped seeds that after seven strokes will not overcome any of the fraction partitions fall into the container. Setting the height of the fraction partitions chooses the boundary for the fraction. It can also be done by gradation of the height of falling of seeds in the separation duct, which is made by removing rebounding plates from the given level of grading, changing at the same time the number of cascades in column.

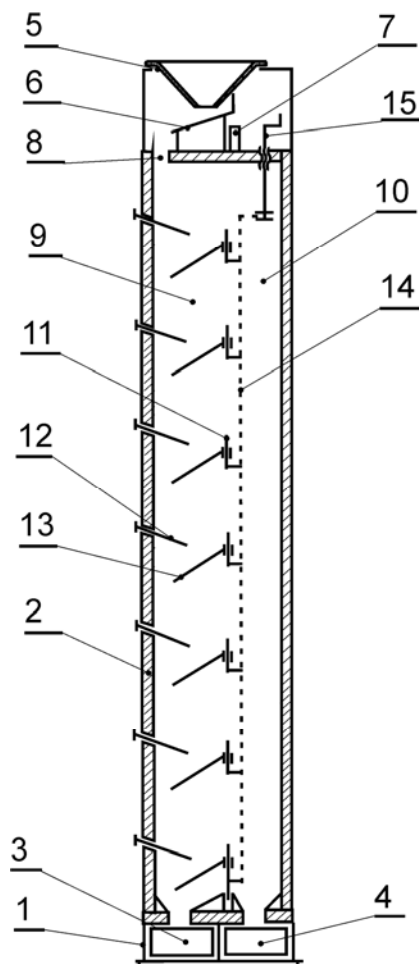


Figure 2. Scheme of the separation column:

- 1 – horizontal base, 2 – separation box, 3 – chamber for undeveloped seeds, 4 – container for healthy seeds, 5 – charging hopper, 6 – chute, 7 – electromagnetic coil, 8 – intake opening, 9 – grading duct, 10 – chute, 11 – fraction partitions, 12 – rebounding plate, 13 – reversible plate, 14 – push rod, 15 – screw and crank mechanism

Conclusions

Lack of knowledge of the seeds physical features, i.e. the criteria of their grading, is evident when operating parameters of separators, mainly imported from Scandinavian countries, are to be set. Those separators are adapted to the characteristics of seeds of species grown there.

Investigation of aerodynamic and elasticity of forest tree seeds, conducted in the laboratory of Department of Forest Work Mechanisations, pointed out significance difference between empty and full seeds, for such species as fir, larch and beech [13, 14]. In relation to them, critical velocity and elasticity can be successfully used as distinguishing features in mechanical seed separation.

Estimation of costs shows that the production expenditure of the presented separators are about three times lower than the Scandinavian ones, offered at present by the market. Described separators are appropriate for grading small, few tens gram portions of seeds, so they could be used not only in kilns and stores, but also in forest gene banks or seed testing stations.

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HELICOPTER LOGGING SYSTEM IN THE NATURAL BROADLEAF FORESTS OF IRAN

The Natural Broadleaf Forests (i.e. the Hyrcanian Forests) of Iran are located in the north of Iran near the Caspian Sea, which is the commercial forest in Iran. For many reasons the main harvesting system in these forests is the skidding system and the helicopter logging system is used in the small parts and special cases. This paper will discuss the helicopter logging system which was used in central of the Hyrcanian forests of Iran and compare with the old system.

Keywords: Helicopter logging, Hyrcanian Forests, Forest Harvesting, logs

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Вертолітна система лісозаготівлі в природних широколистяних лісах Ірану

Природні широколистяні ліси (Гірканські ліси), які є комерційними, розташовані на півночі Ірану біля Каспійського моря. Головно, в цих лісах застосовується наземне трелювання, але на невеликих площах, в окремих випадках, може використовуватися для транспортування деревини вертоліт. Наведено порівняльну оцінку вертолітної та традиційної наземної систем лісозаготівель в центральній частині Гірканських лісів Ірану.

Ключові слова: вертолітна система лісозаготівлі, Гірканські ліси, колоди.

Introduction

Natural broadleaf forests of Iran (i.e. the Hyrcanian Forests) are the only commercial forests in Iran, which cover about 1.8 million hectares in land area of Iran. Most of these forests are located in the steep terrain with high slopes on the Alborz Mountains overlooking the Caspian Sea. The length of these forests strip is about 1000 km with width of about 30 km.

Chainsaws are used for cutting the trees. Because the logs diameters of trees, chainsaw operations use long bars. In general, one chainsaw is run by two people. After

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