Selected New Machines in Seed Sector

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Abstract. In 2006, the total value of the seed sector in the world exceeded 50 billion USD. Seed value of commercial transactions increased during the period of 1970-2006 five times. This part of the economy, because of participation in food production, has always played an important role in the world. According to the International Seed Federation (ISF), three key countries in the world seed industry in 2011 were the U.S., China and France. This increasing speed of the development the seed sector and the growing competition in the market, made seed companies to undertake activities to improve the quality of offered seed material. Harvesting, drying and cleaning of seeds is the second, after breeding, most labour consuming stage in seed production. It significantly affects the final quality of seeds. Due to high competition on market one of the ways to compete is to lower cost when keeping the same quality. It could be reached by using new machines to process seeds. The paper gives examples of some of them. Based on the materials collected in 2011 in selected seed companies in Italy and France, some new or already known but modified, machines were presented. These are: combine to collect seeds of the cucurbit plants, spiral separator in sets, belt machine with across direction of the belt, electromagnetic separator, multichannel photocell separator, pressure machine for unthreshed dry fruit, robot to pack seed bags on a palette. The progress in this area consists on either creating a new machine, enlarging the use of already existing machine, increasing their effectives through using new materials or their other arrangement on the working place.

Keywords: seed, sector, cleaning, improve, market, production

INTRODUCTION

In 2011, the total value of the seed sector in the world exceeded 50 billion USD. Seed value of commercial transaction increased during the period of 1970-2011 five times. This part of the economy, because of participation in food production, has always played an important role in the world. According to the International Seed Federation (ISF), three key countries in the world seed industry in 20011 were the U.S., China and France. This increasing speed of the development of the seed sector and the growing competition in the market, made seed companies to undertake activities to improve the quality of offered seed material. This effect can be achieved using a new, or modifying existing, equipment used for cleaning and sorting of seeds. Therefore, this part of the seed sector, like other departments, trying to improve seed cleaning equipment to lower their costs and increase competition in the market.

MATERIALS AND METHODS

Description of the new machines were based on visits to selected Italian and French companies in 2011.

These were: Cooperativa Agricola Cesenate, Suba, Sativa and Anseme in Italy and the French companies: Bujol and Clause-Tézier. Based on photos and descriptions obtained from these companies, drawings with the signs were made. The key element here was photography, and descriptions and drawings showing how a machine works.
RESULTS AND DISCUSSIONS

1. Combine to collect seeds of the cucurbit plants

The Italian company Cooperativa Agricola Cesenate has developed a new self-propelled harvesting machine for harvest seeds of cucurbit plants directly from the field. Fruit must be first separated by hands and lay down on the field in order to ripen. Then, a harvester comes on the field. It takes fruit from the field by a picker (1) and transports them to a special rotary drum (2), where they are cut and crushed, and then pass the remnants of the pulp with the seeds into the plastic bag (3), while the fruit remains to move to the rotary drum (4) and are left on the field (5). The new machine increases the efficiency of harvesting, and thus lowers the cost of seed production.

Fig. 1. Combine to collect seeds of the cucurbit plants

2. Spiral separators single in a sets moving around

Spiral separator operating principle is based on the difference in shape amongst individual seeds. The mixture of seeds from a hopper (1) is given in advance of spirals and rolls down the inclined surface. The machine has 2 channels: internal (2) and external (3). Seeds with a regular round shape due to the centrifugal force, gain more speed falling out over the edge of the internal channel, go to the external one. Spiral separator is not a new machine in the seed sector, but putting in a rotation, or putting them in a set and rotate is a new approach to this well-known for years machine. Spiral separator itself has no moving parts. Its action can be adjusted by changing the rate of a flow of the seed mixture. The main disadvantage of this device is the lack of flexibility. The ability to change the diameter or angle of the spiral would increase the species range cleaned. Although this machine is often used in seed companies because it is simple and economical to operate, still is not so effective due to its capacity limits – this is especially true for large seed lots of a few tones, e.g. cabbage seeds. Placing a few spiral separators rotating on a common basis, accelerates the movement of seeds, which can increase performance and allows for the simultaneous cleaning of large batches of seed material. New approach to spiral separator is possible to combine them into sets. This allows to significantly increase the efficiency of cleaning, especially large batches of seeds the Italic Brassica group plants.
3. Belt machine with across movements of the belt

The belt machine with vertebral movements of the belt has been known for years. Its working principle is based on difference in seed’s morphology. The smooth seeds will slope down the belt, where as the rough ones will be dropped on the top. In recent years, Western companies have developed a new type of this machine with across direction of movement of the belt. In the machines of this type, cotton or other material is used horizontally at a constant angle. Is also a constant rotation speed shaft. Seeds roll on the tape on the different paths, depending on the coefficient of friction. Seeds with a smooth casing of the seed roll almost immediately. Seeds with a rough bark, roll angles, depending on the coefficient of friction.

Thus, it is possible the simultaneous distribution of seeds to more than two fractions. Modern technology has allowed the production of synthetic plastic, which can successfully replace the canvas. Devices with a tape made of plastic, are characterized by much higher precision cleaning. This was, it possible to extend the range of species cleaned to radishes, cabbage, kohlrabi, and mustard. The negative effect of lateral tape motion is reduced efficiency of the machine.
4. Electromagnetic separator

Weed seeds are often similar in shape, size and weight of the seeds of the cultivated species. The surface of some of them (e.g. dodder, ryegrass) is not smooth, characterized by a roughness. This allows us to separate them with an electromagnetic separator. To do this, one must mix the seeds with specialized mass of iron powder (1). Smooth seeds will not stop the basic grade of powder on surface, while the coarse weed seeds will be covered with an even layer of substance. To facilitate the coating, the seeds can be wetted by water, oil or both of these liquids. The powder coating composition of the seeds contains iron filings, often mixed with other substances. It gives the seeds the properties of ferromagnetic (2). Smooth seeds are still diamagnetic, neutral to magnetic fields (3). Today, the manifolds are placed magnets can produce more powerful electromagnetic field. Works are also on the development of the composition of the powder with the best properties, allowing for more accurate cleaning. This way, it becomes possible to clean the seeds of species with increasing roughness smaller difference compared to seeds of unwanted. This feature is used now a days for cleaning the onion and leek seeds. New technological approach to this machine lies in the fact that it serves today as to separate seeds with seeds cracked and, therefore, not suitable for trade.

Fig. 4. Electromagnetic separator

5. Multichannel photocell separator

Multichannel photocell separator is today one of the most modern machinery use in processing in seed sector. It works by using differences in seed coat colour. Seed mixture placed in the hopper (1) is directed to the conveyor (2), from which it goes to the sorting chamber (3). In the chamber, are placed photocells (4), which, depending on the colour of individual seeds, transmit pulse to the electrode. Seeds darker than the specified pattern receive a positive charge (5). Then the seed stream flows between two electrically charged plates recalcitrant. As a result of an electric field, the track falling seeds with positive charge, is changing. Seeds brighter than the benchmark, not fitted with an electric charge, fall freely (6). Outlet of the machine is equipped with adjustable baffles allow a precise breakdown of the seeds into two fractions. Device described above, but already known in the seed industry for over 20 years does not guarantee the exact distribution of all seeds, for example, due to the uniformly stained. There was also a problem, to make sure that the photocell "sees" the whole seed colour from all sides.
Therefore, in the newer generation machines, its work of photocells is controlled by a computer. Thus, seeds can be divided based on the percentage of specific staining of seed coat. Technically progressive miniaturization of photocells, allows us also to put more photocells in one machine. Thus, the latest devices come with an increasing number of channels and photocells. All these modifications are intended to increase the separation efficiency. Programming the device, using a computer, extended the range of species to as onion, leek, radish and cabbage.

![Fig. 5. Multichannel photocell separator](image)

**6 Pressure machine for unthreshed dry fruit**

This is a new machine constructed at Cooperativa Agricola Cesenate seed company in Italy. It is used for crushing dried, unthreshed fruits. They are dry and very hard pods and pods of beans and radishes, which, despite repeated threshing is not opened, and you can not extract seeds from them.

![Fig. 6 Pressure machine for unthreshed dry fruit](image)

The machine consists of hopper (1) for seed and two bands: the supporting (2) and clamping (3). The distance between them is regulated by means of bolts (4). Tape force generates crushing the fruit and extract from them the seeds (5). Italy's climate is characterized by lack of rainfall from May to September, when the bean and radish seeds pods are ripen in the field. The machine is very useful for the production of seeds of these species.

**7 Robot to pack seed bags on palette**
Robot for stacking bags (1) on pallets of seed is a device which had been adopted from other industries. It has a built-in sensors (2) which regulate the precision light barrier arm (3) motion, and computer software. Robots have appeared simultaneously in seed companies in the U.S., Japan and the EU. This device is particularly useful when the seeds are chemically dressed before sowing. Using a robot helps to improve safety in the workplace.

![Image of robot](image)

**Fig. 7 Robot to pack seed bags on palette**

**CONCLUSION**

Most significant progress relates to the collection, cleaning and packing of seeds. Cleaning is not the only way to improve the quality of seeds. Currently, much higher hopes associated with physiological methods, such as seed conditioning or the use of substances extracted from the seeds of separation as factors. The seed processing is dominated by two trends: modernize the existing machinery or mechanized work done by hand so far. There is a new approach to the already well-known machines, where attempts to improve the quality of seeds obtained. The future of seed production is associated with reduced costs of seed production (McDonald, Copeland, 1997) and the use of machines such as seed quality evaluation of flow cytometry (Śliwińska, 1999). Another criterion is the safer environment in the production of agricultural and horticultural what can be achieved, inter alia, by the replacement of natural chemicals, such as essential oils (Chen, Holubowicz, 2010).

**REFERENCES**

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