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TECHNICAL CONSIDERATIONS REGARDING TO HARVESTING PATATOES AND CARROTS EQUIPMENT

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ABSTRACT

Potatoes and carrots are two plants of great importance in human life. The two vegetables are grown on increasingly large surfaces, which have led to the need to mechanize their planting, maintenance and harvesting technologies. In the continuation of the material, we will find some types of potato, carrot and root crops for both small surfaces and large and very large surfaces.

The harvesting technologies of the two plants are similar, so for the types of potato or carrot picking machines (beet, onions, etc.) and leaves the crop on the furrow, the same type of machine can be used. The diversity of these harvesters is very high from one-row or two-row universal trailed to self-propelled harvesters specialized in harvesting a particular crop, which, through a single pass, can do all of the following: dislocation the harvesting material, sorting, collecting and loading them directly into containers, transport trailers or in their own hoppers with automatic downloading capabilities.

INTRODUCTION

The potato has appeared in America in the tall and humid regions of Peru, Colombia, and Ecuador. In Europe the potato was brought much later, after 1800 becoming an important crop for countries such as Germany, France, England, the Netherlands and Belgium [5]. Carrot originates in southwest Asia in the area of Afghanistan today, in Europe the carrot emerged during the XII-XIV centuries [6].

Potatoes and carrots are two vegetables that can be harvested mainly with the same type of equipment. In addition to their use in human food, potato can be a raw material in the food industry, for making spirits, starch, dextrin and glucose, the remaining residues can be used in animal feed (swine, cattle), while carrots have multiple therapeutic properties combating a wide range of conditions, being very rich in vitamins, sugars and mineral salts.

Today the potato is spread throughout the world and is the fourth energy source of rice, wheat and corn [7]. The carrot is harvested according to the period of harvesting: at the sowing in November harvesting takes place in July-August, at the spring sowing - the harvest is done in August and in the summer sowing - the harvest is done in October [4]. From the point of view of the growing season potato varieties are divided into: early with the vegetation period 70-90 days, the semi-vegetation period with the vegetation period 90-100 days, the semi-late (100-110 days) and late (over 110 days) [16]. Early crops intended for consumption are harvested when the tubers reach a size of more than 30 g, respectively, in the case of potato crops intended for summer consumption in the autumn and winter, the technical maturity corresponding to when the gills are dried at a rate of 70%.

The harvesting of potatoes and carrots can be done manually (with special hoes or forks), semi-mechanized (using plow or potato machines on a row or 2 rows) and

mechanized with self-propelled harvesters. The quality of mechanized harvesting of potatoes and carrots has increased and has developed much in recent years.

MATERIAL AND METHOD

The potato harvesting process includes the following operations: removal of the potatoes; deploying the tubers in the soil and separating them from stools, timbers, earth, stones, etc.; collecting and loading tubers in transport means. Prior to storage or recovery, the potato tubers are sorted and calibrated. The mechanized harvesting of potatoes can be done in two variants: the first of several passes and the second one-pass harvesting.

The multi-pass harvesting method consists of the mechanical or chemical destruction of the veils, followed by the phase in which the tubular dislocation is performed and their separation from the soil, with the help of other specialized machinery. FIG. 1 is a schematic and cross-sectional view of a MTV-4 potato mowing machine formed by a traction bar 1 which is attached to a low power tractor, the rotor shaft 2, the rotor housing 3, the active elements 4, the hydraulic cylinder 5, horn plate deflectors 6, supporting wheels and Aadjustment of working height 7 [15].

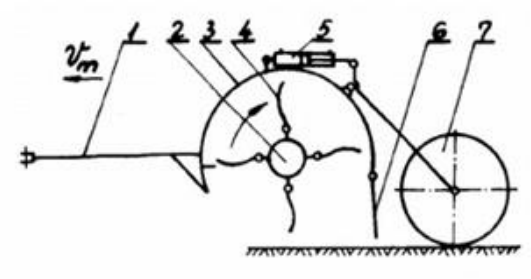


Figure 1. Haulm removing equipment

In the second phase, you can get the potatoes, carrots, etc. which can be on a row or two rows in different constructive solutions.

a) b)

Figure 2. Potato and onion harvesting machine
a) front view b) lateral view

In Fig. 2 it is presented a potato harvesting machine made by Digger, which is designed to work with a tractor with a capacity of 15-25 kW. It can operate in a region with a 6% slope [8].

Figure 3 ***a) Z655 potato harvesing machine b) RAVAK KY-1 potato harvesing machine***

In Fig. 3 b) is presented the RAVAK - KY 1 potato harvester on a row, which works with a 22 HP tractor. The conveyor is driven by a cardan shaft; the working depth is 180 mm [17]. The machine produced by Bomet Fig. 3 a) is specially designed to remove potatoes, carrots, beets, onions etc. and is recommended for small-scale farms with light and dry soils, with medium compaction and minimal weeds on the ground. It is made up of an adjustable depth coulter, which transfers potatoes (carrots, etc.) to a vibrating sieve with adjustable intensity separating them from the ground. [9].

In our country Mecanica Ceahlau manufactures and commercializes MRC2 potato harvester model [10]. In Figure 4 it is shown a MRC. For driving this requires a tractor with a power of 45 HP, the spacing between the rows must be 0.75 m, the working depth is up to 12 cm, with a weight of 420 kg.

Figure 4. ***MRC 2 patato harvesting machine***

The single-pass harvesting method consists of performing all the operations in the harvesting process at the same time. The method is applied when harvesting is carried out with a potato, carrots, etc. harvester.

A potato harvester consists mainly of: potato coulter for displacement of the patato nests, grate separators, vibratory sieves, conveyor blades or rubber fingers, fingers, squeegees or rotary hoists, pneumatic cylinders for shredding of the earth blasts and the separation of the tubers of time, organs for separating the veils, separators of the impurities tubers, hydraulic systems, bunkers of different capacities. To eliminate the impurities that pass through the active organs of the combines, up to 4 people are used which are placed on specially designed platforms.

In FIG. 5 it is represented the constructive principle of a potato harvester, carrots and especially root crops. Thus, in FIG. 5 a) there is a schematic diagram of the model of a potato machine consisting of: 1 drum for compressing the processed material, 2 dislocation blade, 3 rolling grid, 4 sorting table, 5 rubber fingers, 6 exhaust basket of the useful products, 7 the rolling train of the machine, 8 vertical disc knives [11].

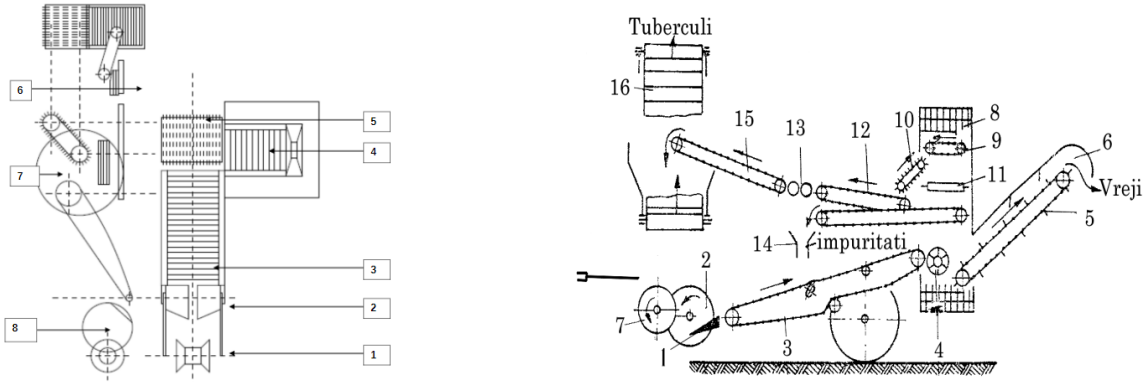


Figure 5. ***Scheme of principle for patatos harvesting machine***

In FIG. 5 b) the potato harvester has the following components: 1 coulter, 2 disk knife for limiting the tuber area, 3 grate conveyor, 4 rotor with pallet, 5 fingers for separating the poles, 6 special casing, 7 profiled drum, 8 elevator, 9-barrier transporter, 10 transporter with elastic fingers, 11 transversal conveyor, 12 - first manual sorting band, 13 rubber discs, 14 gutter for removing impurities, 15 second sorting belt, 16 elevator with squeegees for tubers [2].

In FIG. 6 it is a PYRA 1600 potato harvester combine harvester manufactured by Agromet Pilmet in Poland. The technological design of the combine comprises the following parts: 1 row coping roller 2 coulter, 3 rope, 4 roll, 5 rotation ax, 6 main conveyor 7 impurity conveyor, 8 roller, 9 and 10 intermediate conveyors, 11 rollers, 12 loading conveyor bunker, 13 bunker for potatoes, 14 scrapers, 15 gutters, 16 elevator 17 supports, 18 hydraulic cylinders, 19 conveyors. The combination requires the proper operation of a tractor with a minimum power of 50 PF. It is also equipped with an acoustic signaling system for emergency stopping of the machine in the event of damage to the hydraulic system or machine tool [1].

Figure 6. a) ***PYRA 1600 combine***

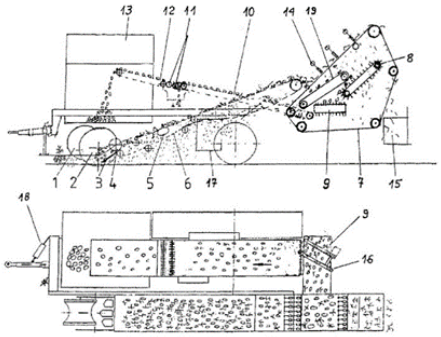


Figure 6 b) Constructive scheme

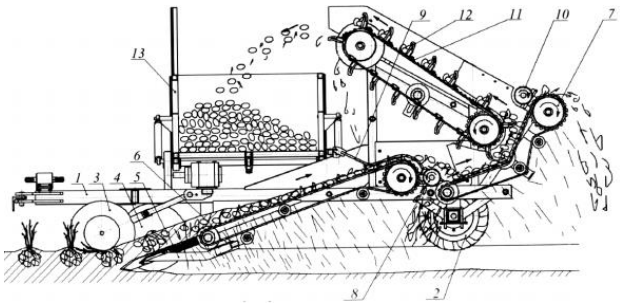


Figure 7. ***Scheme of principle***

In FIG. 7 is presented another variant of the scheme of principle of the technological flow of a potato harvester: 1 frame, 2 wheels, 3 rolls, 4 cutting discs, 5 coulters, 6 - main

conveyor, 7 L-shaped conveyor , 8 rolls, 9 - separation bars, 10 - roll selection, 11 loader conveyor, 12 scrapers, 13 - bunker. The technical characteristics of the combine are as follows: Length 4035 mm, width, 1875 mm, height 1930 mm, weight 1350 kg, hopper capacity 0.75 t, distance between rows 500-700 mm, operating speed 5.0 km / h, speed travel 20 km / h, productivity 0.2 ha / h, working depth - 250 mm [3].

The BOLKO potato and vegetable harvester (Figure 8) can be driven by a 30-40 PF tractor. The three existing constructive variants for this type of combine are: with a 1250 Kg bunker (Figure 8 a), with a loader and platform with a loading capacity of 500 kg (Fig. 8 b) and with direct draw in the trailer (Fig. 8 c).

a) BOLKO *b) BOLKO S* *c) BOLKO T*

Figure 8. *BOLKO* potato and vegetable harvesing machine

This model of the BALKO machine can be attaced to an onion picker or a special carrot picking device. The operating speed is between 1.5-5 Km / h, the discharge height is 1.1-2.5 m for the embodiment of Fig. 3a, and up to 3.1 m for the embodiment of Fig. 3c, [12].

The Dewulf R3060 potato and carrot harvester (Figure 9) is a new 3-wheel self-propelled APH group with a lightweight maintenance and high productivity [13]

Figure 9. *DEWULF R3060* combine

Figure 10. *ASA-LIFT CM-100E combine*

ASA-LIFT CM 100E carrot harvester is a model of self-propelled carrots and root crops harvester and also features an elevator for carrots in the trailer. The ASA-LIFT CM-100C collects carrots directly into boxpallets. Both versions are equipped with a hydraulic cylinder for adjusting the working depth, 150 mm knives on a protective support. [14]

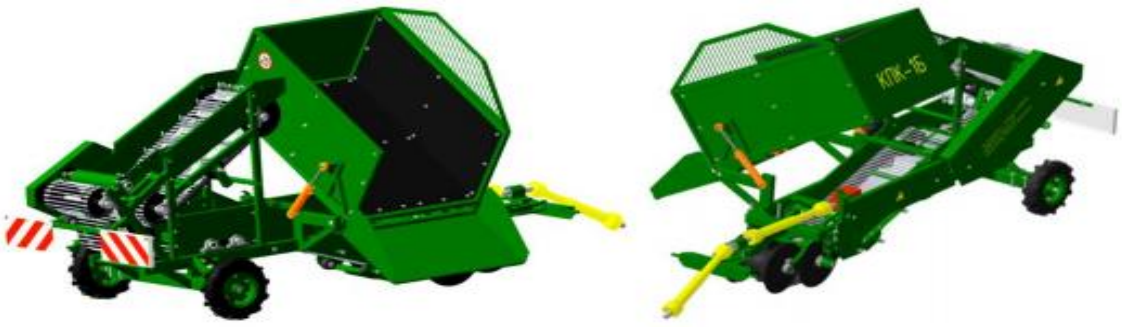
In Figure 11 b) is represented a four-row self-propelled potato harvester with an electronic harvest depth adjustment system on each row. The combination is equipped with a 400 hp engine, the working speed is between 7-13 km / h, the hopper has a capacity of 2.5 m3, the working width is 2.9 m and the unloading system is provided with conveyor belt with scraper, the height up to 4.35 m.

a) Ploeger carrots harvesting combine b) Ploeger potato harvesting combine

Figure 11. ***PLOEGER carrots and potatoes harvesting combine***

RESULTS AND DISCUSSIONS

Based on the studies performed on the MKP3 potato harvester shown in FIG. 12 a) and b), the optimal values of the operating parameters were determined as follows: machine speed Vm = 1,3 m / s, feed conveyor speed Vc = 1,2 m / s, angle α = 15°, and angle β = 70°. These were obtained from experimental studies carried out on a potato harvester model shown in FIG. 7 b).



a) b)

Figure 12. ***MKP3 potato harvesting machine a) back view, b) front view***

The overall dimensions are: Length 4035 mm, width, 1875 mm, height 1930 mm, weight 1350 kg., Hopper capacity 0.75 t, distance between rows 500-700 mm, operating speed 5.0 km / h, speed movement 20 km / h, productivity 0.2 ha / h, working depth - 250 mm.

In the experiment, the following parameters varied: machine speed in working range Vm = 0.79 ... 1.85 m / s, feed conveyor speed on Vc = 0.88 ... 1.25 m / s, angles α = 10 ... 25□ and β = 50 ... 80□ (where the two angles are the inclinations of the two conveyors relative to the horizontal).

The minimum value of the impurities was obtained at the lowest values of Vm and β and the highest value of Vc, the change in the value of α from 10 to 25□ being insignificant. If Vm and Vc grow, the losses also increase and if Vc and β increase the degree of damage to culture decreases [3]. Among the general technological requirements for potato and carrots spinning machines, we mention:

- ✓ □ the percentage of dislodged tubers exceeds 97%
- ✓ □ The percentage of injured tubers is below 2%
- ✓ □ The percentage of losses should not exceed 2%
- ✓ □ the percentage of impurities in the harvested mass is below 6% [15].

CONCLUSIONS

Increasing the quality of potato and carrot harvesting is a permanent concern for agricultural machinery manufacturers. The carrots, patatos and roots in general have modernized and diversified, increasing the degree of automation of many harvesting operations.

These machines must meet a number of conditions such as: the lowest possible energy consumption, the operation of the technological process of harvesting at the best possible quality, the reduction of harvesting costs, the simplicity of machine handling, the cleaning and collection systems are the more efficient so that the volume of impurities decreases and the injury of the harvested material is insignificant.

Whether trailed or self-propelled, harvested on a row, two or more rows, the latest generation potato and carrot harvesters are highly productive. A single root harvesting plant by changing optional equipment can harvest potatoes, carrots, onions, beets, etc. However, it must be emphasized that these high-performance root harvesters with complex impurities cleaning systems, which also have large volumes of storage of roots, become very heavy, resulting in excessive soil compaction.

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