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ENERGY SAVING TECHNOLOGY FOR HARVESTING OF ROOT CROPS

The root crops of sugar, fodder beet and root chicory are important technical crops of agricultural production. Sugar beet is the primary source for obtaining raw materials, from which sugar is produced as a strategic food product, which is in great demand in the world market and other important minor products of its processing. The root crops of fodder beet and tops are valuable components of the feed ration of farm animals. Fodder beet, in the feeds of the autumn-winter period, is the main type of juicy feed stuff that has a large amount of carbohydrate nutrients, especially useful for dairy cattle. Introduction in the diet of dairy cows of fodder beet helps to increase feed intake by 8...11%, increase the milk production of animals by 10%, assimilation of organic substances by 5...8% [1].

The roots of chicory are used in the pharmaceutical, coffee, alcohol and confectionery industries. The value of chicory is determined by the content of various kinds of saccharin's in root crops that is inulin, fructose, glucose, various kinds of acids and vitamins useful for the organism and rare in natural products, vitamins, and also trace nutrients including iron, copper, zinc, chromium. The products of two processing plants in Ukraine, which are loaded at 15...25% of the production capacity, are exported to France, Belgium, Hungary, Russia, the Republic of Belarus, and the United States. Despite the growing demand for raw processing products of root chicory, the acreage of this strategically important agricultural crop in Ukraine is annually reduced by 20...30% due to unsatisfactory provision of harvesting tools for root crops, such as harvesting of the tops and digging of root crops [2].

A special place in this list belongs to root crops, which for their agrobiological properties have a sufficiently high and stable energy potential among agricultural crops. With proper cultivation techniques, they can provide yields of up to 100 t/ha, and sometimes much more. Modern varieties and hybrids of root crops with a high yield potential give a large yield of clean energy and biogas. After the processing of root crops, energy carriers are obtained in the form of sugar, bioethanol or biogas, fig.1.

On the basis of the research of technological processes that realize the cutting of the tops of root crops and technological schemes of top harvesters and technical equipment of domestic and foreign production, it can be stated that at the modern stage the top harvesters compete harvesting of the tops without gauging capitulum of root crops [3].

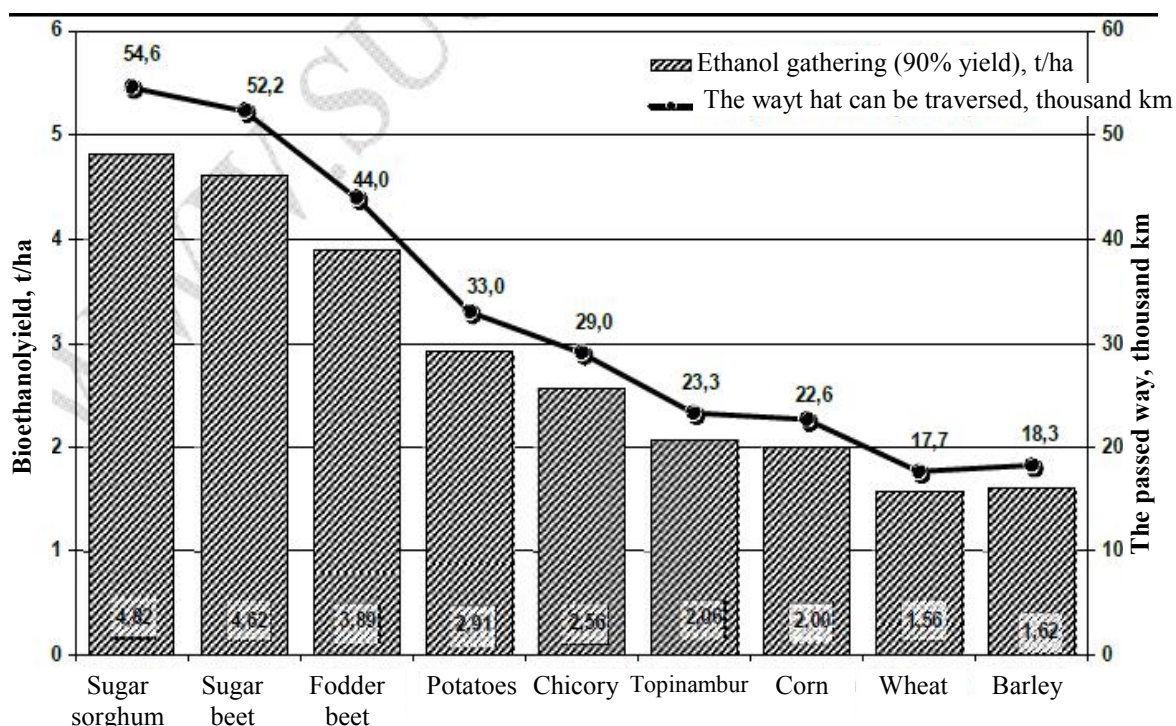


Fig. 1 Potential yield of bioethanol per 1 hectare of crops

The presence of a wide variety of layout schemes for the top harvesting mechanisms is directly related to both the top harvesting techniques (Fig. 2) or the use of tops (the use of haulm for food or as organic fertilizer by spreading it onto a harvested field) and with technological operations that realize Every single technology of its harvesting.

Considering the specific biological characteristics of the tops of root crops (significant yields), mechanized harvesting of the tops can provide for five main adjacent technological operations: cutting the main mass of the tops, transporting the cut tops with forming into the roll or spreading it onto the harvested field, cutting off the deads of the tops from the capitulum of root crops, loading into the transport.

The first stage of single-phase harvesting of root crops, which is mainly used in the countries of the European Union and in most cases in Ukraine and the Russian Federation, is a two-stage harvesting tops by top harvester modules in composition of self-mobile hopper combine harvester: the first stage is the cutting the main mass of tops; second stage is the cutting the deads of tops from the capitulum of root crops.

At the first stage, such operations are performed (Fig. 3): cutting of the main mass of the tops with knives of the rotary top cutter with its simultaneous grinding; feeding the milled tops by the motion path to screw conveyor; transportation of milled tops with spiral by spiral turns of the screw conveyor; delivering the tops by spiral turns through the discharge ring of the screw conveyor into the roller spreading the tops to the harvested field by rotary top thrower which is installed behind the discharge ring of the screw conveyor.

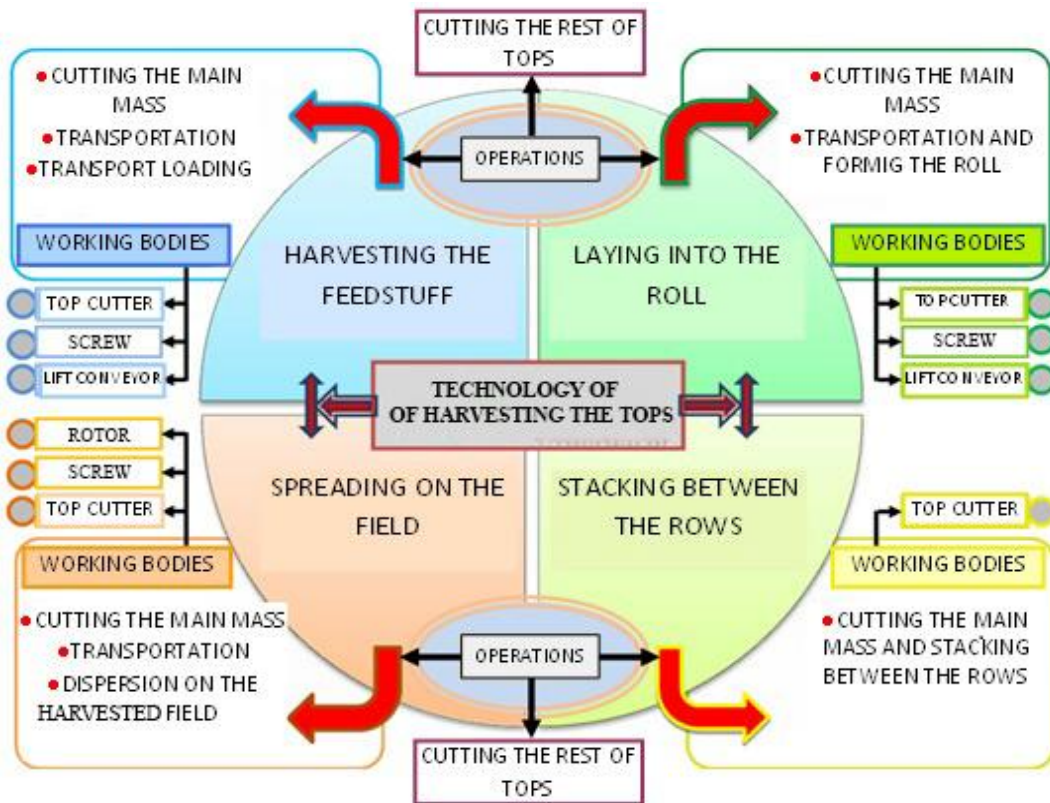


Fig. 2. Technology and operations of harvesting the root crops

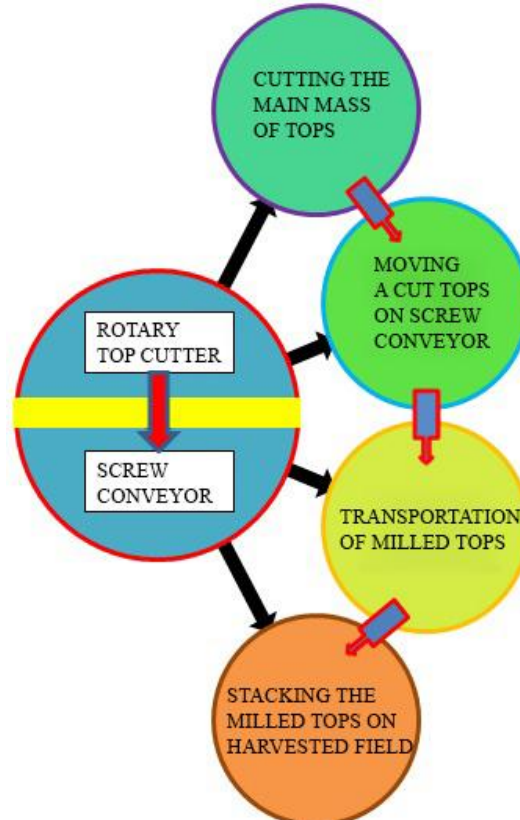


Fig. 3. The operations of harvesting the main mass of the tops

In the second consecutive stage, the deads of the tops from the capitulum of root crops are trimmed with various designs cutters which are made as a “passive passive-feeler chisel”.

Therefore, the development of new designs of technical means for harvesting tops of root crops should be based on world experience in reducing energy resources, taking into account the peculiarities of domestic agrotechnical, technical-economic, ecological and other production requirements.

The working hypothesis is based on the solution of the scientific task of reducing energy costs during the harvesting the main mass of tops, which provides for the elimination of intermediate link in the design-layout scheme of the module for harvesting the tops in the form of transport element made in the form of a screw conveyor and installed in the guide channel.

Considering the world trend of a single-phase method of harvesting root crops by modern self-mobile vehicles, which provide for the block-modular principle of their construction, we proposed an improved method of harvesting the main body of root crops.

References

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