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Study of distribution of height of protrusion of heads of sugar beet root above the soil

Aim. Reduce the weight loss tsukronosnoyi separation process sugar beet tops of heads of roots by creating conditions for automatically adjusting the cutting height tops. **Methods.** The study was conducted on a new experimental laboratory-developed field installation with further processing of the results on a PC statistical methods. **Results** As a result of the processing results of the study confirmed the hypothesis that the distribution of protrusion heights Root heads above ground does not deny the law of normal distribution. Established limits of its statistical characteristics, which have the following meanings: standard deviation - at 20- = 30 mm, expectation - $t = 40- 60$ mm. **Pronunciation** Designed and manufactured completely new laboratory and field installation and conducted her experimental studies confirmed the hypothesis of normal distribution law protrusion heights roots and gave every reason to develop a new system of automatic cutting height adjustment tops of heads of sugar beet root crop harvesting machine on modern technical level.

Key words: sugar beets, harvesting machines, losses, sugar weight, height of protrusion, statistical distribution.

Formulation of the problem. Beet growing is a strategic branch of agro-industrial development in the leading countries of Europe and America. One of the most responsible operations in sugar beet production is harvesting, because at this stage most of the harvest harvested may be lost. Losses of sugar beet root crops are caused by many factors, because the process of collecting beet root crops is quite complicated and costly. However, one should distinguish between them the most important. This is the most important factors due to the poor operation of beet-harvesting machines at the stages of separating the wedge from root roots at the root and subsequent excavation of non-root cores from the soil. Increasing the contamination of the cornflower beet pulp with a sugar green mass by only 1% of the established norm reduces the yield of sugar by 0.1%, and for storage in kagates with the contents of the hive about 4%, the daily losses of sugar make up an average of 0,02% [1, 2, 6, 7, 14]. At the same time, modern beet slaughter machines produced in Europe and America cause a significant loss of zucchini mass caused by an excessive cut of root crops that contain a significant amount of sugar. Therefore, it is currently relevant to search for such technical solutions that will enable these losses to be avoided. There are many types of technical means for copying roots of root crops, but the most widely spread today are drill-picking machines with a non-copious method of separating the grip. The purpose of the research is to reduce the loss of sugarcane in the process of separating the sugar beet hinges from the root crops through the creation of prerequisites for automatic adjustment of the height of the crop cut. **The object and method of research.** The object of research is the technological process of separating the wedges from root crops of sugar beet pulp on the root with a cork cut. The results of the measurements were processed by statistical methods using a personal computer. In the designs of modern beet-harvesting machines, mainly rotary-type hinges were used that cut the heads of the root crops at one level relative to the surface of the soil. Selection of the specified cutting height is carried out in accordance with generally-known recommendations, but it is often difficult to observe it in practice, which

is sometimes impossible in view of the well-known nature of the distribution of the height of the heads of root crops over the surface of the soil. In spite of this, the consumers of beet harvesting equipment always have a problem with the choice of rational cut-off height values in specific production conditions (different characteristics of the height of the protrusion of root crops). Mostly this problem is solved by empirical methods (visual assessment of the quality of work after several passes) that need to be repeated several times. This leads to unproductive labor time costs, which in turn reduces the harvesting performance. Also, in this case, there may be cases of wrong selection of cut height, which leads to increased losses of sugar. Therefore, it is advisable to develop an automatic regulator that could solve the problem of setting the cut height automatically during the operation of the bucket harvester. To develop such a regulator it is necessary to determine the type of static distribution of the heights of the protrusions of root crops. This question was investigated by a number of scientists [6, 7, 9], which in most cases prefer the normal distribution law. However, the reliability of these results is doubtful, since it is impossible to obtain a large sample by manual sampling. Therefore, for the final evaluation of the field of sugar beet crop before harvesting (estimating the distribution of plants in a row, distribution with respect to the soil surface, determining the losses during harvesting), an experimental laboratory-field plant was developed (Fig. 1, 2).

Fig. 1. Scheme (3E model) of a laboratory setting for measuring the protrusion of head roots of beet sugar above the level of the top of the soil and its executive body

Fig. 2. Laboratory installation during conducting an experimental study

Fig. 3. Distribution of heights of protrusion of roots of sugar beet roots over the surface of the soil: $t = 40$ mm: N - number of cobs (1 - $a = 10$ mm; 2 - $o = 20$ mm); V_g - ground grape mass (3 - $o = 10$ mm; 4 - $o = 20$ mm); NZL - terrestrial sugar-bearing mass, which contains a hinge (5 - $o = 10$ mm; 6 - $o = 20$ mm)

Its functional-structural scheme includes: input and output modules, module for measuring the block, sensor unit for registering seed parameters. Also created algorithm of the program of control of the process of measuring the height of the protrusion of sugar beet root crops heads over the surface of the soil. The constructive scheme of the laboratory-field installation was developed and its sample was made. A system of gyroscopes and accelerometers was designed to study the effect of the beet-shaking machine fluctuations on the stability of the process by the working organs for the harvesting of sugar beet root crops. In addition, the constructive scheme of the measuring block has been developed, an electronic module for controlling the process of measuring the parameters of placement of sugar beet root crops heads over the surface of the soil has been made. Measuring unit contains probes indicating the presence of root crops, probe to identify the position of the base of the machine and the height of the head of the root of the root of the surface of the soil. The conducted study of the distribution of heights of the protrusions of root crops relative to the level of soil surface is presented in Fig. 3. In this case, the graphs are based on the results of a large sample (50 thousand measurements), which was processed on a PC in accordance with the developed program Mala. Presented in Fig. 3 curves show the distribution of the heights of the sugar beet root beet root heads over the surface of the soil, depending on its intervals, shown on the abscissa. According to the results of the study, it was established that the statistical distribution of heights of the heads of root crops over the level of the soil surface corresponds to the normal distribution law (Fig. 3). The boundaries of changing its statistical characteristics are as follows: averaging attenuation $a = 20 - 30$ mm, mathematical expectation $t = 40 - 60$ mm. The following parameters of quality of sugar beet harvesting roots are established: loss of sugar content - 4%, remains of the hinges on root crops - 2, root crop damage - 3%. Using the previously constructed mathematical model [6, 7], losses of sugarcane weight were obtained depending on the height of the uncorked cut of root heads of sugar beet root crops. The graph (figure 4) shows the add-on dependence (for one individual case) for the following distribution parameters: $m = 40$ mm and $a = 20$ mm. However, in the same field, these parameters may vary within the limits indicated in Fig. 3. Therefore, the statistical distribution parameters need to be monitored dynamically. If their changes change, respectively, the mass loss curve (Fig. 4), as well as the optimal value of n_2 . With the help of the graph (Fig. 4), we can predict the loss of the mass of root crops and the contamination of their residues in the specific conditions, after having obtained the statistical parameters of the distribution (t , a), and also using the mathematical model presented in the papers [6, 7]. This, in turn, will make it possible to create

an automatic system for evaluating the parameters of the root crops and to quickly adjust the height of the cut of the hips from the heads of co-rice sugar beetroots to significantly reduce the losses of the sugar mass.

Fig. 4. Dependence of losses of sugar-bearing mass from the height of the crop-free cut of root crops of beet sugar

Conclusions

As a result of an experimental study of the distribution of heights of the heads of root beet sugar beet over the level of the soil surface, the hypothesis that this distribution corresponds to the normal distribution law is confirmed. A fundamentally new laboratory-field plant was designed and manufactured, and experimental research carried out on it provided all the grounds for the development of a new system of automatic adjustment of the height of the cut of the hips from the heads of the sugar beet root crops to the modern machinery of harvesting machines.

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