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Duration Of Storage And Quality Of Sugar Beet Roots.

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ABSTRACT

The article presents the results of studying the changes in the quality of sugar beet roots in dependence on hydrothermal conditions and a hybrid. It was established that F1 FMC 120 hybrid was more resistant to unfavorable storage conditions. After 60 days of storage, the weight of root crops decreased, on average by hybrids, by 9.02% compared to the initial mass. The minimum increase in potassium content over 60 days of storage was noted in root crops of normal-sugary type - by 0.617-0.683 mmol / 100 g. Accumulation of sodium in the root crops during the storage period was 0.006-0.014% of the mass and more it was accumulated by hybrids of normal-sugary and sugary type. The greatest content of α-amino nitrogen after 60 days of storage was in a hybrid of a sugar type, and hybrids of normal type were characterized by the smallest accumulation. A sugar-type hybrid is characterized by small sugar loss in molasses - 2.38%.

Keywords: beet, sugar, potassium, sodium, alpha-amino nitrogen.

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INTRODUCTION

In the period of mass beet harvesting sugar factories can not immediately process all the harvest, roots are laid for storage in piles [1-4]. When stored, root crops must consume their own stores of metabolites, in particular sucrose, to maintain vital activity. Therefore, processes of hydrolytic decomposition predominate during storage, and there occur natural changes in the chemical composition of root crops, leading to deterioration of technological properties of sugar beet roots, a decrease in sucrose content and the accumulation of non-sugars - mostly potassium, sodium and alpha-amino nitrogen, preventing extraction of crystallized sugar remaining in the molasses [5-11]. Reducing the technological qualities of sugar beets depends on many factors, including the duration and conditions of storage before processing. Therefore, it is very important to evaluate modern varieties and hybrids not only in terms of yield and sugar content, but also the ability to preserve high technological qualities of roots during storage.

METHODOLOGY

The research was conducted in 2013-2015. Following hybrids of sugar beet (F1) were studied in the experiment: 1 - PMC 120 (St.); 2 - Compact; 3 - Gerakl; 4 - Spartak; 5 - XM 1820; 6 - Nero; 7 - Triada; 8 - Badia; 9 - Volga. Before beet laying the ground area was leveled, watered and treated with hydrated lime (0.2 kg / m2). Piles (correctly stacked heaps of root crops for above-ground storage in the field-without shelter) were formed during the harvesting period, placed near the road from north to south. The dimensions of the piles are 3-4 m in height and the width of the base is 12-16 m. The control of the change in the quality indicators of the root crops was carried out after 60 days of storage according to the generally accepted procedure for laying mesh samples [12].

RESULTS

It was found that after 60 days of storage, the weight of root crops decreased by an average of 9.02% in hybrids compared to the weight before laying. The largest weight loss of root crops was noted in 2013, when the loss was more than 10% compared to the weight before laying, which is associated with high temperatures during storage. The lowest weight loss - 6.54% was observed under favorable hydrothermal conditions of the storage period in 2014. Among all the studied hybrids, F1 PMC 120 hybrid was most resistant to unfavorable storage conditions. For the remaining hybrids, differences in root weight loss were insignificant (Table 1).

Table 1: Loss of weight of sugar beet root crops after 60 days of storage, %

Hybrid F_1	2013	2014	2015	Average for 2013-2015
Normal hybrid type				
PMC 120 (St.)	10,01	6,27	9,05	8,44
Compact	10,09	6,40	9,59	8,69
Gerakl	11,02	6,58	10,03	9,21
Spartak	11,40	6,33	10,24	9,32
Normal-yielding type of hybrid				
XM 1820	10,41	6,85	10,61	9,29
Nero	11,01	6,42	10,39	9,27
Normal-sugary type of hybrid				
Triada	10,21	6,73	10,10	9,01
Badia	10,40	6,57	10,03	9,00
Sugary type of hybrid				
Volga	10,65	6,71	9,58	8,98
Hybrid average	*10,58*	*6,54*	*9,96*	*9,02*

In 2015, when the temperature of 10.8 ° C was recorded during the first half of the storage period, mass losses were greater in hybrids of normal-yield type and amounted to 9.05-10.61%.

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In the piles, after 60 days of storage, there was revealed the development of root rot - 0.67-2.97% of root crops weight. According to the content of decayed root crops, the hybrids were distributed as follows: RMS 120 <Compact <Spartak <Nero <Triada, Badia <Gerakl <XM1820 <Volga.

The change in external and internal signs of the quality of sugar beets during storage depends on many factors. Thus, the statistical processing of the data obtained in the experiment revealed a direct dependence of root weight loss on the temperature regime during the period of two months storage of root crops in unattended piles (Figure). Graphical interpretation of the obtained equation allows us to conclude that the loss of root crop mass increases sharply with an increase in air temperature. Thus, at an average daily temperature of 5 ° C, they would be 5.44% of the initial mass over a thirty-day period, and twice at a temperature of 15 ° C.

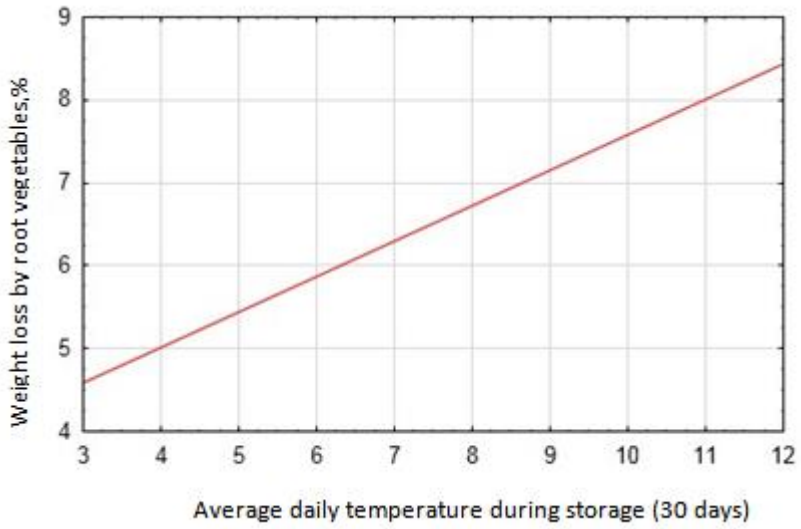

Figure 1: Dependence of root crops weight loss (y) on average daily temperature (x) during storage

In the process of hydrolytic decomposition during storage, complex carbohydrates are converted into simple carbohydrates, some of which are expended on respiration, while the rest are accumulated in raw materials, and the content of trisaccharides increases. As a result of protein hydrolysis in beet juice, peptides and amino compounds appear. All this leads to a deterioration of technological qualities of sugar beet roots, a decrease in the content of sucrose and the accumulation of nonsugars. In 2013, after 60 days of storage, the smallest loss of sugars - 0.73% - was noted in the F1 PMC 120. In the remaining hybrids studied, the loss of sugars is 1.5-1.78 times higher, and the greatest among them was the F1 Volga hybrid (1.22%). This trend can be traced in the following years of research. On average, over the years of observations, the greatest loss of sugar content during the 60 days of storage was noted in hybrids of the normal-sugar type - Triada and Badia - 1.03-1.04%, and the smallest in the PMC 120 and Spartak hybrids - 0.77% and 0, 95%, respectively (Table 2).

Table 2: Change in the quality of sugar beet roots during storage,% on natural moisture

Hybrid F_1	Sucrose content		Potassium		Sodium		α- amino nitrogen	
	Initial value	After 60 days of storage	Initial value	After 60 days of storage	Initial value	After 60 days of storage	Initial value	After 60 days of storage
Normal hybrid type								
PMC 120 – (St.)	17,87	17,10	0,204	0,239	0,021	0,030	0,034	0,085
Compact	18,07	17,07	0,176	0,214	0,026	0,037	0,027	0,080
Gerakl	18,30	17,32	0,160	0,204	0,026	0,036	0,030	0,084
Spartak	18,07	17,12	0,200	0,219	0,027	0,036	0,031	0,084

Normal-yielding type of hybrid								
XM 1820	18,17	17,14	0,193	0,233	0,022	0,028	0,032	0,086
Nero	18,10	17,14	0,196	0,231	0,025	0,032	0,029	0,085
Normal-sugary type of hybrid								
Triada	18,60	17,57	0,148	0,174	0,014	0,026	0,026	0,087
Badia	18,63	17,59	0,151	0,175	0,013	0,027	0,025	0,084
Sugary type of hybrid								
Volga	18,90	17,88	0,126	0,161	0,010	0,023	0,018	0,077

In the process of storage, complex physiological, biochemical, microbiological and other processes occur in the root crops, which lead to the loss of sucrose and to the accumulation of molasses - mainly potassium, sodium and alpha-amino nitrogen, which prevent the extraction of crystallized sugar.

As the studies showed, on average over three years of observations, the largest content of potassium before storage was in beet roots of following hybrids: F1 PMC 120 (0.204% by weight), F1 Spartak (0.200% by weight) and F1 Nero (0.196% by weight) . The remaining hybrids with a genetic focus on obtaining, in the first place, high yields, had the amount of potassium in the range of 0.160-0.193% of the mass. In hybrids with a genetic orientation to produce high-sugar root crops, the potassium content was 0.126-0.151% by weight, which corresponds to 3.2-3.9 mmol / 100 g. During 60 days of field storage the potassium content in root crops increased 1.2 times in all hybrids in comparison with the initial content (4.203 mmol / 100 g), including 1.21 times in normal-type root crops, 1.19 - in normal-yielding type, 1.17 - in normal-sugary type and 1.27 - times in sugary type. The greatest increase was noted in the hybrids of the Volga, Gerakl and XM 1820. The greatest amount of potassium, regardless of the hybrid, was observed in 2015, the least in the more favorable year - 2014.

At the beginning of storage, the sodium content was also greatest in the root crops of normal and normal-yielding hybrids, and amounted to 0.021-0.027%, or 0.913-1.157 mmol / 100 g. In normal-sugary type hybrids, the amount of sodium was slightly lower than in the hybrids of the yielding type - 0.577 mmol (F1 Badia) and 0.627 mmol (F1 Triada). By the time of harvesting, 0.450 mmol / 100 g of sodium or 0.010% of the mass was accumulated in the root vegetables of the sugary hybrid Volga. For the entire storage period, the content of sodium in root crops increased on average 1.7 times compared to the initial amount, which was 0.790 mmol / 100 g. In hybrids of normal type, it increased 1.4 times, of normal-yielding type - 1.27 times, of normal-sugary type - 1.93 times and of sugary type - 2.27 times.

During storage, the content of α-amino nitrogen in root crops, as well as sodium, decreased in the following order: normal hybrids - normal-yielding - normally-sugary - sugary. The highest content of "harmful" nitrogen was in the roots of hybrids F1 PMC 120 and F1 XM 1820 and amounted to 0.034% and 0.032% of the mass respectively, the smallest - in the hybrid F1 Volga (0.018% of the mass). The detection of "harmful nitrogen" showed that the amount of it increased over the 60 days of storage by an average for hybrids 3.3 times in comparison with the initial content, including 2.7 times in normal-type root crops, 2.83 times in normal-yielding type, 3.36 in a normal-sugary type, and 4.29 times in a sugary type. It should be noted that the accumulation of α-amino nitrogen was also determined by storage conditions. Close to the optimal storage, the temperature in 2015 against the background of heavy rainfall contributed to the fact that the content of "harmful" nitrogen in the roots was less than in 2014 and 2013.

The technical quality of sugar beet is determined by the amount of sugar in molasses. For 60 days of storage, its quantity in molasses increased in comparison with the initial content by 1.7 times. Standard losses of sugar during the formation of molasses, on average for three years, for all hybrids amounted to 2.67%, including for hybrids of normal-harvested type - 2.77, of normal type - 2.73, of normal-sugary type - 2.59 and of sugary type - 2.38%. The greatest losses were noted in the hybrids RMS 120 and Spartak (2.78-2.79%), the smallest in the hybrid Volga (2.38%). The increase in sugar losses is associated with a change in the content of molasses - potassium, sodium and "harmful nitrogen" or amino nitrogen, which contains protein, ammonia and amide nitrogen. These substances interfere with the extraction of sugar from molasses. The more of them is in root crops, the less purified sugar is obtained.

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CONCLUSIONS

1. After 60 days of storage, the weight of root crops decreased, on average by hybrids, by 9.02% compared to the initial mass. The F1 PMC 120 hybrid was more resistant to unfavorable storage conditions.

2. The minimum increase in potassium content over 60 days of storage was observed in hybrids of normal-sugary type - 0.617-0.683 mmol / 100 g. The greatest increase was noted in hybrids Volga, Gerakl and XM 1820.

3. Accumulation in the root crops of sodium during the storage period was 0.006-0.014% of the mass, depending on the hybrid, and it was accumulated more by hybrids of normal-sugary and sugary type.

4. After 60 days of storage the content of α-amino nitrogen in the root crops of hybrids of normal type increased by 2.5-2.9 times compared with the initial state, of hybrids of normal-yielding type - 2.7-3.0 times, of normal-sugary type - 3.3 times, and of the sugary type - more than 4 times.

5. The greatest losses of sugar in molasses were noted in hybrids RMS 120 and Spartak (2.78-2.79%), the lowest in hybrid Volga (2.38%).

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