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INFLUENCE OF PLACEMENT METHODS ON PRESERVATION AND QUALITY OF JERUSALEM ARTICHOKE TUBERS WHEN STORING IN CONDITIONS OF A VEGETABLE STOREHOUSE

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The article presents data from two years of research to identify the most optimal of traditional methods of storing Jerusalem artichoke tubers of the Skorospelka variety. As part of the study, the following methods of storage tubers were studied: a polypropylene bag, a plastic box, and a bulk in a vegetable storehouse with unregulated conditions. Shelf life was 102 and 194 days. In the first year of storage, the weight loss of the tubers was 16.4-22.5%. In the second year, the highest storeability of the tubers was recorded when stored in bags; the weight loss was 5%. The method of storage of Jerusalem artichoke tubers in polypropylene bags in some years provided less damage from diseases and the storeability was 49-64% higher compared with storage in a bulk and in plastic boxes. The method of storing tubers of Jerusalem artichoke in a bulk contributed to their wilting by 1.7-5.8% compared with storage in bags and boxes. During storage of Jerusalem artichoke tubers in boxes, their carbohydrate complex was destroyed to a lesser extent. The fiber content in terms of absolutely dry matter was reduced by 0.2-2.5%, or 0.9-1.1% less than when stored in bags and in a bulk. The content of water-soluble carbohydrates was 2.5-4.8%, which was 3.3-7.4% less than during storage in a bulk. According to the results of research, the most optimal of the traditional methods of Jerusalem artichoke tubers storage was the storage in bags.

Key words: Jerusalem artichoke tubers, method of storage, habit, storeability, biochemical composition.

Introduction

Today Jerusalem artichoke is widely studied as a highly productive fodder crop. High feed quality of green mass and tubers of Jerusalem artichoke make it possible to use this culture in fodder production [1]. The culture does not require the use of pesticides, it is frost-resistant, and is also balanced in micro- and macro-elemental composition, contains a large amount of magnesium, potassium, phosphorus, calcium, iron [5, 7, 11, 15]. The tubers are a complete and environmentally friendly food product that can perform preventive functions [2, 5, 10, 12]. To date, the problem of its poor storeability has not been solved [9]. Due to the low keeping quality of the tubers, the possibility of their use in the development and introduction of new dishes at catering establishments is exclusively seasonal [3]. Traditionally, this culture is stored in containers, boxes, bags, bulk in storage and ground pits. There is a method of storage in trenches with the installation of forced-air ventilation [8, 14]. Also, the authors investigated an unconventional method of storing tubers - in regulated gaseous media (RGM) – N_2 (70%) + CO_2 (30%); O_2 (75%) + CO_2 (25%). Regardless of its composition, RGM lead to germination of the tubers in 73 days after storage, as well as to a significant reduction in quality indicators, which allowed considering this storage method for a short period of time [4]. The most promising ways are storage at negative temperatures, in the form of a powder, and storage in a fresh, untreated form (in a plastic bag with holes) [6, 13].

The purpose of the study was to determine the optimal method of storing Jerusalem artichoke tubers in a vegetable storehouse.

Objectives of the study:

1. To assess external changes in the quality of Jerusalem artichoke tubers during storage.
2. To determine the keeping quality of the tubers.
3. To analyze the biochemical composition of Jerusalem artichoke tubers after storage.

Methods and materials

To solve the tasks, in 2016 and in 2017 a one-factor experiment was laid out according to the following scheme: 1 – storage in plastic boxes, 2 – storage in polypropylene bags, 3 – storage in a bulk. The object of study was the tubers of Jerusalem artichoke of the Skorospelka variety. A non-ventilated vegetable pit without regulation of temperature and humidity conditions was used for the experiment. Air temperature during storage was 1-3°C. The method of preparation of a tuber included cleaning from the ground and drying. The repetition was threefold. The mass of a sample deposited was 3000 g. The date of laying the experiment in the first year of the study was 29.11.2016, the date of the extraction from the pit was 11.03.2017. The total storage period was 102 days. The date of laying the experiment in the second year of the study

was 21.10.2017, the date of the extraction from the pit was 02.05.2017. The total storage period was 194 days. The storeability, the habit of the tubers and their biochemical composition were analyzed according to generally accepted methods and state standards.

Results

An analysis of external changes in the state of tubers during storage showed that in the first year of the research, none of the storage methods made it possible to preserve the custom look of tubers. After storage, spoiled tubers afflicted with diseases in all three storage methods were observed. In the second year of research, the tubers stored in bags, after 194 days of storage, fully preserved the custom look and met the requirements of GOST 32790-2014 “Fresh Jerusalem artichoke. Technical conditions" (Table 1).

According to the results of the first year of research, the weight loss of tubers was 16.4-22.5%, depending on the method of storage. A significant difference in this indicator between the studied methods of storage was not observed. There was a tendency to increase the storeability of tubers when stored in bags. According to the results of the second year of research, tubers stored in bags, had a better storeability; weight loss was 5%, which was significantly lower (by 64.2%) than during storage in bulk. More than half the weight of the tubers (53.8%) was lost during storage in boxes (Table 2). One of the main causes of poor storeabil-

Table 1. Dynamics of changes in the external condition of Jerusalem artichoke tubers during storage

Control date	Method of storage		
	Box	Bag	Bulk
2016 год			
29.11.2016	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.
05.01.2017	Habit – there are tubers with black spots. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.	Habit – there are tubers with black spots. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.
11.03.2017	Habit – there are tubers with black spots. Tuber turgor – high. Disease contamination – there are tubers with mold. Sprouted and frozen tubers were not found.	Habit – there are tubers with black spots. Tuber turgor – high. Disease contamination – there are tubers with mold. Sprouted and frozen tubers were not found.	Habit – there are tubers with black spots. Tuber turgor – high. Disease contamination – there are tubers with mold. Sprouted and frozen tubers were not found.
2017 год			
21.10.2017	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.
02.01.2018	Habit is typical. Tuber turgor – high. Disease contamination – there is fungal mold. Sprouted and frozen tubers were not found.	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.	Habit – atypical, dried tubers. Tuber turgor – low. Disease contamination – there is fungal mold. Sprouted and frozen tubers were not found.
24.02.2018	Habit is typical. Tuber turgor – high. Disease contamination – the beginning of the process of decay. Sprouted and frozen tubers were not found.	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.	Habit – atypical, dried tubers. Tuber turgor – low. Disease contamination – there is fungal mold. Sprouted and frozen tubers were not found.
02.05.2018	Habit is typical. Tuber turgor – high. Disease contamination – there are tubers affected by fungal diseases. Sprouted and frozen tubers were not found.	Habit is typical. Tuber turgor – high. Disease contamination is absent. Sprouted and frozen tubers were not found.	Habit – atypical, dried tubers. Tuber turgor – low. Disease contamination – there are tubers affected by fungal diseases. Sprouted and frozen tubers were not found.

ity of Jerusalem artichoke tubers stored in boxes and in bulk in the second year of research was increased air humidity, which caused a high defeat of the tubers with pathogenic microorganisms in these variants [8].

Table 2. The weight loss of tubers of Jerusalem artichoke during storage

Storage method	Weight loss of tubers, %	
	2016	2017
Box	21,6	53,8
Bag	16,4	5,0
Bulk	22,5	69,2
HCP_{05}	$F_{fac} \leq F_{05}$	60,6

In the first year of research, a significant increase in the dry matter content was observed during storage in bulk by 1.7% (HCP_{05} = 1.3%) compared with the indicators obtained during the laying of the experiment (Table 3).

And in the second year of research, a significant increase in dry matter was observed in all the investigated storage methods, due to the drying of the tubers. However, the highest dry matter content in the tubers (30.4%) was also noted during storage in bulk, which was 5.2-5.8% higher than with the other methods of storage. A significant decrease in the content of crude fiber in the first year of research was noted during storage in a bag (by 1.1%) and in bulk (by 0.9%), in the second year of research – during storage by all the studied methods. A significant decrease in the content of water-soluble sugars was observed when using all the investigated storage methods. The deterioration of the biochemical composition of the tubers during storage can be explained by the consumption of carbohydrates for respiration – the main process of metabolism, as well as under the influence of fungal and bacterial infections.

Table 3. Biochemical composition of Jerusalem artichoke tubers

Indicator	Year	Before the laying	Storage methods			HCP_{05}
			Box	Bag	Bulk	
Dry matter content, %	2016	20.8	20.2	22.0	22.5	1.3
	2017	22.2	24.6	25.2	30.4	0.2
Crude fiber content, % per d.m.	2016	2.6	2.4	1.5	1.7	0.7
	2017	5.3	2.8	1.0	3.5	0.6
Water-soluble sugars content, % per d.m.	2016	23.1	20.6	19.4	17.3	1.2
	2017	24.4	19.6	19.5	12.2	2.2

Conclusion

1. The method of storage of Jerusalem artichoke tubers in polypropylene bags in some years provides less damage from diseases and storeability is 49-64% higher compared to storing them in bulk and in plastic boxes.

2. The method of storing tubers of Jerusalem artichoke in bulk contributes to their wilting by 1.7-5.8% compared with storage in bags and boxes.

3. During storage of Jerusalem artichoke tubers in boxes, their carbohydrate complex is destroyed to a lesser extent. The fiber content in terms of absolutely dry matter is reduced by 0.2-2.5%, or 0.9-1.1% less than when stored in bags and in bulk. The content of water-soluble carbohydrates is 2.5-4.8%, which is 3.3-7.4% less than during storage in bulk.

4. According to the research results, the most optimal of the traditional methods of storing Jerusalem artichoke tubers is storing in bags.

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INFLUENCE OF PLANTING TIME AND TYPES OF THE PLANTING MATERIAL ON THE SURVIVABILITY AND PRODUCTIVITY OF COMMON HOP (*Humulus lupulus L.*)

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In hop production, the time of the planting and the type of planting material are of great importance, mainly because the condition of the hop plant and the care technology during the growing season in the first and subsequent years depend on the time of the planting and the material used. The article presents data on the results of research when planting new hopyard with different types of planting material and the time of their planting. Under production conditions, shortening the period of low market fruiting and obtaining a good harvest of cones in the second year are possible only when using annual seedlings as planting material. In the first year, the survivability and yield of plants during the autumn planting by annual seedlings is higher than during the spring one. In the second and third years of planting, the dependence of the crop on the type of planting material used was maintained. In less favorable years survival rate decreased, and in more favorable years it increased. The best option for planting hopyards was the autumn planting of annual seedlings in the first and second decades of October, which allowed us to maintain survivability at a high level.

For novice farmers and enterprises, in order to save money, stem cuttings can be used as planting material when laying hopyards. During the period prior to the beginning of abundant fruiting of hops, the