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RESEARCH ARTICLE

Implementation of the potential of dietary potato varieties in the conditions of the Northeastern Forest-Steppe of Ukraine

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Abstract

To determine the level of implementation of genetic resources of dietary potato varieties when grown under organic farming conditions, without the use of chemical substances, and to determine the maximum possible potential of the varieties involved in the study, as well as to analyze the content of dry matter and starch in dietary potato varieties. The analysis of the obtained results indicates that dietary varieties have different productivity indicators. The highest indicators of tuber quantity per plant (6.4), yield (571 g/plant), and starch content (11.8%) among other varieties. The Solokha variety also showed higher productivity results compared to the Khortytsia and Gurman varieties, with marketability (97%), yield (354 g/plant), dry matter (20.30%), and starch content (11.0%).

Keywords: Productivity, Dietary potato varieties, Starch, Yield, Biochemical composition of tubers

Introduction

In the conditions of increasing potato production and its use as a food product, the problem of quality is acute. Scientists are constantly searching for connections between individual quality indicators and physical, anatomical and physiological signs of tubers and their biochemical composition (Abby, 2016; Long Jiang–xue et al., 2018; Bondarchuk et al., 2021; Furdyha, 2022). An objective assessment of various quality characteristics and their variability depending on the variety makes it possible to satisfy the consumer's requirements (Long Jiang–xue et al., 2018; Kang et al., 2020; Pysarenko et al., 2022). In recent years, special attention has been paid to innovative non-thermal technologies that have a positive effect on textural, chemical and food changes (Stark et al., 2020; Goffart et al., 2022). Modern world science affirms the key role of potatoes in ensuring global food security in the future (Kokovikhin et al., 2020; Hryhoriv et al., 2021; Hussain et al., 2021).

Considering global trends towards healthy eating, there is a growing interest in obtaining dietary products with increased antioxidant content, which consequently helps people combat diseases. The cultivation of special potato varieties, both in Ukraine and worldwide, is a relevant direction for ensuring food security.

The dietary potato varieties involved in the study, belonging to the medium ripening group (vegetation period 70 days-75 days), are characterized by varietal differences, economic and valuable traits, and have different biochemical compositions of tubers (Podgaetskyi et al., 2002; Eid et al., 2021; Hryhoriv 2022). The biological characteristics of the varieties differed in starch content, antioxidants, vitamins, tuber formation features, sizes, and the rate of growth and development of vegetative mass of plants (Navarre et al., 2016; Wijesinha–Bettoni & Mouillé, 2019; Fumia et al., 2022). Our main task is to increase the productivity potential and implementation of dietary potato varieties with high or even moderate expression of a complex of agronomic traits (Lombardo et al., 2013; Ierna & Mauromicale, 2018; Kazimierczak et al., 2019).

Materials and Methods

The research was conducted in the educational, scientific and industrial complex of the Sumy National Agrarian University. The research field is located in the Sumy district of the Sumy region, Ukraine, geolocation data 50°52.742 N latitude, 34°46.159E longitude, 137.7 m above sea level (50°52'46.6"N34°46'07.8"E Map date ©2023 Google). The research area is characterized by long–term average indicators: average annual daily air temperature + 7.4°C; annual precipitation – 593 mm. Transition of average daily temperatures through the +10°C mark: downwards – the 3rd decade of September, upward – the 2nd decade of April. The sum of active (> +10) temperatures for April–September is 2768°C. The general characteristic of the studied period (2021–2023) was lower temperatures and more precipitation in spring (compared to the long–term average). The soil of the experimental field is represented by typical chernozem, the arable layer of which is characterized by the following main indicators: humus content – 4.1%, pH – 6.3, the amount of absorbed bases – 31 mg–eq., the content of mobile forms of phosphorus – 11.3 mg/100 g of soil, exchangeable potassium – 9.2 mg/100 g of soil, the content of easily hydrolyzed nitrogen according to Kornfield 11.2 mg/100 g of soil. The experiments were conducted according to the methods described by (Dospekhov 1985, & Kononuchenko 2002).

The study involved dietary potato varieties from various breeding institutions: Solokha, Gurman, Khortytsia (Ukraine), All Red (USA). When laying out experimental plots, each variety was planted with 11 tubers per row, in 4 replicates. The distance between tubers of the same variety was 35 cm, and the row spacing was 70 cm. Statistical processing of the obtained results was carried out using the Statistica program (Tsarenko et al., 2000).

Results and Discussion

According to the (Tab. 1) data, it can be concluded that productivity indicators varied depending on the varietal characteristics of the tubers. The highest marketability indicator was obtained by the Solokha variety (97%). The ALL RED variety had the highest number of tubers per plant (6.4) and the highest yield per plant (571 g). Dry matter indicators were highest in the investigated varieties Khortytsia and Solokha (20.30%). Regarding starch content, potatoes ALL RED and Solokha had the highest indicators (11.8% and 11.0%, respectively).

Table 1. Productivity indicators of dietary potato varieties after harvest (2023)

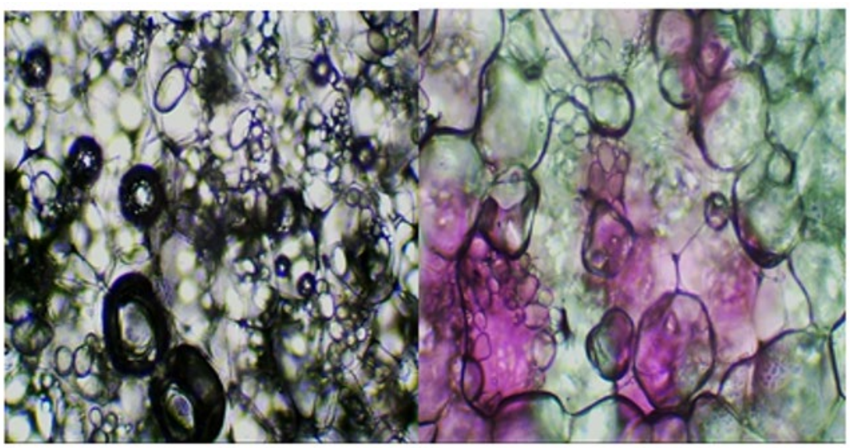
Variety name	Marketability, %	Number of tubers, pcs./plant	Yield, g/plant	Dry matter, %	Starch content, %
Khortytsia	95	3	200	20.3	10.7
All Red	95	6.4	571	14.55	11.8
Gurman	88	5	189	17.3	10.2
Solokha	97	4.7	354	20.3	11
Vodohray	95	4.5	386	20.3	12.1

After storing potatoes in storage, we re-determined the indicators of dry matter and starch. Additionally, using a microscope, we compared the starch grains of dietary potatoes (Tab. 2).

Table 2. Comparison of potato indicators during storage

Variety name	Dry matter		Starch content	
	After harvest	After storage	After harvest	After storage
Solokha	20.3	19.3	11.7	10.9
Solokha (new)	19.8	17.3	20.5	14.2
Khortytsia	20.3	15.3	10.7	10.3
Khortytsia (new)	19.3	18.05	20.1	16.1
ALL RED	18.05	15.3	14.3	12.2
Gurman	17.3	14.55	10.2	9.8
Vodohray (control)	20.3	19.8	12.1	9.3

Analyzing the indicators of dry matter and starch content in potatoes, we can draw certain conclusions. The amount of dry matter in dietary potato varieties at harvest varied depending on the variety. After a period of storage in the warehouse, these indicators decreased in all varieties, as did the starch content. This indicates that after storage, dry matter and starch began to decompose into other compounds, thus reducing their quantity relative to the initial indicators (Fig. 1).



Khortytsia Solokha

Figure 1. Photo of starch grains under a microscope (magnification 10X)

Analyzing the data from the photos, it can be said that the starch grains of different potato varieties differ in both shape and quantity. The Khortytsia potato variety has more oval grains compared to Solokha.

Conclusions

The analysis of the obtained results indicates that dietary varieties have different productivity indicators. The ALL RED variety had the highest indicators of tuber quantity per plant (6.4), yield (571 g/plant), and starch content (11.8%) among other varieties. The Solokha variety also showed higher productivity results compared to the Khortytsia and Gurman varieties, with marketability (97%), yield (354 g/plant), dry matter (20.30%), and starch content (11.0%).

The indicators of dry matter and starch varied between the period when the tubers were just harvested from the field and after storing them in the warehouse at an optimal temperature of +5°C. Determination showed that after storage, the content of substances in potatoes decreased.

Our further research will focus on increasing the yield of dietary potato varieties by obtaining virus-free potato seed material based on in vitro, and we will also evaluate the biochemical composition of tubers.

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