THE INFLUENCE OF CLIMATE CONDITIONS ON THE NUTRITIONAL QUALITY OF SOME POTATO LINES TESTED IN CULTURE ON SANDY SOILS FROM SOUTHERN OLTENIA

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Keywords: potato, stress, biochemical composition.

ABSTRACT

In this paper are presented the results regarding the biochemical composition of the 7 potato lines studied at Dăbuleni Research-Development Station for Plant Culture on Sands in conditions of thermo-hydric stress. The obtained results highlighted differentiations depending on the genotype and depending on the climatic conditions of the 2 years of study (2020-2021). A high content of total dry matter, above the average of 22.87% presented 4 of the 7 potato lines studied, the highest values being recorded at line L 1901/11 (27.09%). Starch, the main biochemical component of potato tubers, showed values between 12.86% in 2020 and 13.08% in 2021, the highest average values of starch content in tubers being determined in line L 1895/1. The vitamin C content was higher in all the lines studied in the climatic conditions of 2021 year.

INTRODUCTION

Increasing potato productivity is important to satisfy the growing food demand of a growing population. However, potato plant growth and tuber yield are constrained by high temperature, water limitation, soil salinity, and threats with pests and pathogens (Dahal K, et al., 2019).Climate change is likely to further aggravate tuber yield losses by increasing the exposure of potato plants to these stressful conditions.Potato production is influenced by a complex of biological, ecological and technological factors. The factor that most strongly limits production is the drought of May-September, at the time of intense formation and accumulation of tubers, which occurs very frequently in all areas of cultivation in the south of the Romania (Diaconu A. and colab., 2020).Thornton (2002) quoted by Burzo I. and Dobrescu A. (2011) mentions that the optimal temperature for growing vegetative organs of potato plants is 18.3 °C.High temperature (30-35 °C) has an inhibitory effect on the tuberization

process. Lack of water during the formation of tubers prevents the tuberization process resulting in fewer tubers, with different ages, which leads to uneven boiling resistance and reduced yields. Drought during the period of simultaneous growth of shrubs and tubers greatly reduces production, this being the critical period for water of the plant.The potato has a fragile system of regulating water consumption and no longer economically uses water that occurs after relatively short-term deficiencies, thermohydric stress disrupting the entire physiological activity of plants. Therefore, there is an urgent need to adapt to the new challenges posed by climate change, improve the adaptability of potato plants to environmental stress and obtain new varieties, tolerant of heat, drought, insects and pathogens, being the most important and challenging objectives. These challenges can be addressed by identifying stress-related traits at the physiological, biochemical, and molecular levels and deploying them in new genotypes (Dahal K, et al., 2019).The productivity and nutritional quality of the potato are complex notions, determined by the variety through the genetic characteristics it encompasses, being influenced by external factors. The quality of potato tubers refers to a series of internal and external properties, related to their nutritional and commercial value. In the production of potatoes for food and industrial purposes, the content of dry matter and starch are very important. The concentration of these components is determined by the influence of the cultivar (Mareček et al. 2013; Grudzińska et al. 2016), agro-technical and climatic factors (Trawczyński 2016).In order to obtain new potato varieties with superior capacity to respond to abiotic and biotic stress at DăbuleniResearch-Development Station for Plant Culture on Sands, 7 potato lines were studied, which aimed at the production capacity and nutritional quality of tubers in the conditions of establishing the culture on sandy soils in the Dăbuleni vegetable basin, where the frequency of thermohydric stress is high.

MATERIAL AND METHOD

The researches were carried out in the period 2020-2021 at the Dăbuleni Research-Development Station for Plant Culture on Sands (Dăbuleni RDSPCS) and aimed at the influence of climatic conditions on the productivity and quality of some potato lines, in order to select the most adapted genotypes to pedoclimatic conditions in southern

Oltenia. During the vegetation period, the climatic data were recorded at the weather station of Dăbuleni RDSPCS. The experimental variants were represented by 7 potato lines, coming from the National Research-Development Institute for Potato and Sugar Beet Braşov, where they are in full improvement process:

V1 = L 15-1677/2;
V2 =L 15-1876/7;
V3 = L 1895/1;
V4 = L 1901/7;
V5 = L 1901/11;
V6 = L 1901/6;
V7 = L 19-0000/5.

In order to determine the quality of potato production, samples of tubers were harvested at harvest maturity (65-70 days after plant emergence) from which the following determinations were made:
- water and total dry matter - gravimetric method;
- soluble dry matter - refractometric method;
- soluble carbohydrates - Fehling Soxhlet method;
- starch - gravimetric method;
- vitamin C - iodometric method.

RESULTS AND DISCUSSIONS

The climatic conditions registered in the potato vegetation period at the weather station of Dăbuleni RDSPCS (2020-2021) are presented in Table 1.

In 2020 the average monthly temperature was between 7.9 °C in March and 22.0 °C in June, the values recorded being higher than the multiannual average values for the respective months. However, winter came late in March in three episodes, with temperatures of -5.5 °C, with precipitation in the form of snow and rain. The low temperatures of minus 2 °C continued in the first decade of April, these episodes of very cold weather delaying the start of the fangs and the emergence of all the potato lines studied.After the late winter episodes, recorded in March, the temperatures started to increase constantly, reaching maximum values between 29 °C in April and 35 °C in June.The precipitation recorded in these months were 189.37 mm, with 30.84 mm below the multiannual amount for the four months.

Table 1

Air temperature (°C) and precipitation (mm) registered in the potato vegetation period at the weather station ofDăbuleni RDSPCS (2020-2021)

Year	Month/decade	March	April	May	June
2020	I	7.9	9.5	16.9	20.5
	II	8.8	14.5	21.6	21.6
	III	7.0	14.8	15.8	24.0
	Monthlyaverage (°C)	7.9	12.9	17.7	22.0
	Monthlymaximum (°C)	24.7	29	33	35.0
	Monthly minimum (°C)	-5.5	-2	8	6.7
	Precipitation (mm)	62.77	11.6	59.2	55.8
2021	I	5.1	7.8	17.8	18.7
	II	4.4	8.8	16.6	19.7
	III	5.8	12.6	18.5	26.6
	Monthly average (°C)	5.1	9.7	17.6	21.7
	Monthlymaximum (°C)	19.2	26.7	31.8	39.6
	Monthly minimum (°C)	-7.1	-3.9	1.2	10.2
	Precipitation (mm)	116.2	30.6	55	53
1956-2019	Multiannualaveragemonthlytemperature(°C)	6.0	11.9	17.1	21.6
	Amount of multiannual monthly precipitation(mm)	39.48	47.14	62.86	70.73

In 2021, the climatic conditions during the period of growth and development of plants and implicitly of potato tubers were favorable in terms of precipitation, but the average monthly temperatures showed values below the multiannual average for March and April and higher than multiannual average in May and June. In April, 10 days were recorded with temperatures between 2 and - 3.9 °C and differences from night to day of 18.8-20.4 °C.

On the background of high temperatures, correlated with the deficit of precipitations, in May and June the phenomenon of drought was installed, being necessary the irrigation of the potato culture.

From a biochemical point of view, the obtained results highlighted differentiations according to genotype and depending on the climatic conditions of the crop year (Tables 2,3). The total dry matter was between 22.26% in the climatic conditions of 2021 and 23.48% in 2020. Analyzing the influence of genotype on the total dry matter content, the lowest values were recorded at line *L 15-1677/2* (with an average value of 16.09%), and the highest values were obtained at line *L 1901/11* (27.09%).With the exception of line *L 15-1677/2*, all other potato genotypes studied had a total dry matter content in tubers of more than 20 percent, which means that they can be used in industry in the manufacture of various potato products. The percentage of dry matter increases during the accumulation of production, and measures that accelerate the accumulation of production lead to an increase in the percentage of dry matter in the tubers at an early date of harvest (Göncz E., 2011). As the amount of total dry matter accumulates in the tubers, the amount of water decreases, which had an average content of 76.7%.The soluble dry matter was between 5.08% in 2021 and 5.87% in 2020. A soluble dry matter content above the genotype average (5.47%) was recorded in experimental variants 3, 1, 6 and 7, with average values between 5.50-5.90% (Table 2).The main ingredient in potato tubers is starch, whose content is closely correlated with the amount of dry matter. Starch is the most important reserve substance in the plant, being deposited in tubers, where, by enzymatic hydrolysis, it provides glucose to plant organs.The potato genotypes studied on the sandy soils from Dăbuleni had an average starch content between 11.67% at line *L 19-0000 / 5* and 13.68% at line *L 15-1677/2*.According to the potato quality requirements, potato tubers intended for direct consumption must contain 18-22% dry matter and 12-16% starch, while potato tubers intended for chips must contain 20-25% dry matter and 16-20% starch (Lisińska 2000, Grudzińska et al. 2016).From the results obtained it can be seen that most of the lines studied by the content of total dry matter and starch fall into the category of potatoes for consumtion.According to Gabriel and Świeżyński (1977), the value of these characteristics is determined in 72-92% by the yield of tubers, and only in 14-15% by the content of these elements in tubers(Tables 2,3).

Table 2

Potato tubers content in water and dry matter according to genotype and climatic conditions in the study period (2020-2021)

Experimental variant	Water content(%)			Total dry matter(%)			Soluble dry matter (%)		
	2020	2021	Average	2020	2021	Average	2020	2021	Average
V1 = L 15-1677/2	80.89	86.94	83.92	19.11	13.06	16.09	6.0	5.5	5.75
V2 =L 15-1876/7	74.75	74.19	74.47	25.25	25.81	25.53	5.2	4.8	5.00
V3 = L 1895/1	79.58	77.18	78.38	20.42	22.82	21.62	5.9	5.1	5.50
V4 = L 1901/7	75.24	77.55	76.40	24.76	22.45	23.61	5.8	4.6	5.20
V5 = L 1901/11	73.36	72.46	72.91	26.64	27.54	27.09	5.5	4.8	5.15
V6 = L 1901/6	74.80	70.02	72.41	25.20	23.98	24.59	6.7	5.0	5.85
V7 = L 19-0000/5	77.02	79.83	78.43	22.98	20.17	21.58	6.0	5.8	5.90
Average	**76.52**	**76.88**	**76.70**	**23.48**	**22.26**	**22.87**	**5.87**	**5.08**	**5.47**
Limits in the literature			**73-80**			**20-27**			**3.5-6**

Table 3

Amount of starch, C vitamin and average production of potato tubers according to genotype and climatic conditions in the study period (2020-2021)

Experimental variant	Starch content (%)			C vitamin (mg/100 g f.s.*)			Average production (t/ha)		
	2020	2021	Average	2020	2021	Average	2020	2021	Average
V1 = L 15-1677/2	13.82	13.54	13.68	7.60	11.44	9.52	35.24	38.21	36.70
V2 =L 15-1876/7	12.44	13.65	13.05	7.90	9.68	8.79	27.62	35.24	31.40
V3 = L 1895/1	14.4	16.69	15.55	8.80	9.68	9.24	52.00	36.03	44.00
V4 = L 1901/7	11.94	11.65	11.80	8.80	10.56	9.68	20.09	34.34	27.20
V5 = L 1901/11	13.62	12.72	13.17	9.80	12.32	11.06	44.67	24.31	34.50
V6 = L 1901/6	11.67	12.12	11.90	8.80	13.20	11.00	25.62	29.81	27.70
V7 = L 19-0000/5	12.15	11.18	11.67	7.92	16.72	12.32	25.14	10.07	17.60
Average	**12.86**	**13.08**	**12.97**	**8.51**	**11.94**	**10.23**	**32.91**	**29.72**	**31.30**
Limits in the literature			**17.22**			**17**			

*f.s. = fresh substance

Between the average tuber production obtained from the genotypes studied in the period 2020-2021 and the starch content of potato tubers, a polynomial correlation was established, given by asecond degree equation, with a distinctly significant correlation factor (Figure 1).

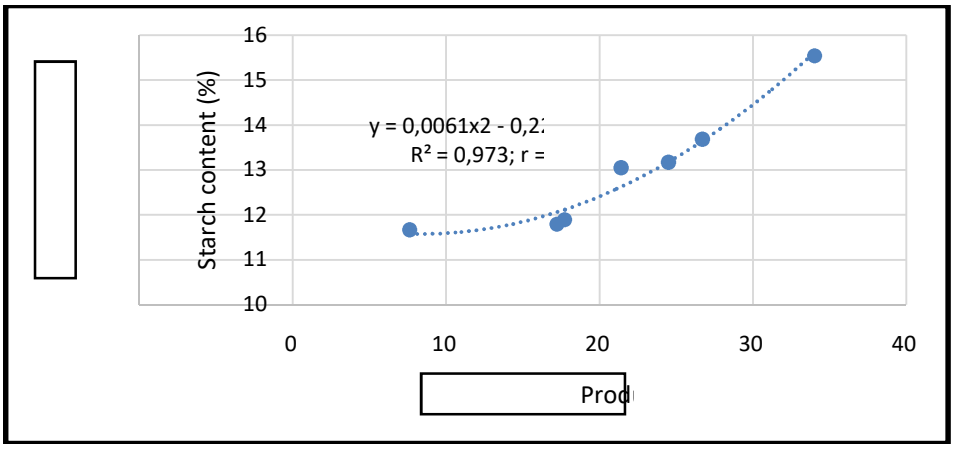

Figure 1. Correlation between tuber production and starch content

The C vitamincontent was higher in all the lines studied in the climatic conditions of 2021 year.The ascorbic acid content of potato tubers also varied depending on the genotype analyzed. Thus, the highest percentage of vitamin C was determined at line *L 19-0000 / 5* (12.32 mg / 100 g f.s.), and the lowest percentage was determined at line *L 15-1876/7* (8, 79 mg / 100 g f.s.).Similar research was conducted by Krystyna Zarzynska and colab. in 2015, which showed that the chemical composition of the tubers was significantly influenced by the variety and weather conditions during the study period, the vitamin C content being between 16.9-23.8 mg / 100g fresh substance.In the conditions of sandy soils from Dăbuleni, the content of C vitamin in tubers can exceed these values, but there are also years when, in unfavorable climate conditions, vitamin C reaches much lower values, as happened in 2020 and 2021.

CONCLUSIONS

The biochemical composition of the studied potato genotypes was influenced by both the genotype and the meteorological conditions during the study period. The total dry matter was between 22.26% in the climatic conditions of 2021 and 23.48% in 2020, the lowest values being recorded at line *L 15-1677/2* (with an average

value of 16.09%), and the highest values were obtained at line *L 1901/11* (27.09%). A soluble dry matter content above the genotype average (5.47%) was recorded at the lines *L 1895/1, L 15-1677/2, L 1901/6* and *L 19-0000/5*, with average values between 5.50-5.90%.Starch, the main biochemical component of potato tubers, showed values between 12.86% in 2020 and 13.08% in 2021, the highest average values of starch content in tubers being determined in line *L 1895/1* (15.55%). The vitamin C content was higher in all the lines studied in the climatic conditions of 2021 year. The highest percentage of vitamin C was determined at line L 19-0000 / 5 (12.32 mg / 100 g fresh substance).Between the production of tubers obtained in the 7 potato genotypes analyzed and the amount of starch in the tubers, a close correlation was established, distinctly significant from a statistical point of view (r = 0.99 **).The results on the dry matter and starch content include the genotypes studied in the category of potatoes for consumption.

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