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The Evaluation of the Potato Collection Samples According to Some Physiological Indicators and the Choosing of the Primary Donors for the Selection

A. G. Eyvazov

Vegetable Scientific-Research Institute
Ministry of Agriculture, Public Legal Entity
Azerbaijan

Abstract

In the article, the results of the evaluation of 20 potato collection samples of different geographical origins are reflected according to some physiological indicators - the leaf surface area, photosynthetic potential, the specific surface density of the leaves, the amount of the chlorophyll in the leaves, total dry and wet biomass. It was determined that the collection samples are divided into fast-growing (89-91 days), medium-fast-growing (92-94 days) and medium-growing (95-97 days) groups according to their ripeness, and into high-yielding (466.0-619.7 cwt/ha), medium-yielding (273.3-424.0 cwt/ha) and low-yielding (224.3-252.0 cwt/ha) sort samples according to their productivity. It was shown that Panomera (32.1 thousand m^2/ha, 2407 thousand m^2·day/ha and in 332.0 mg/100g wet mass, respectively), Elfe (33.9; 2776 and 280.5), Telman (35.8; 2969 and 250.0), Bellarosa (43.2; 3453 and 354.1), Farida (50.7; 4003 and 357.9) sort samples differ according to the leaf surface area, the photosynthetic potential of the plant, and the amount of the chlorophyll in the leaves, and Sifra (5.96 mg/cm^2), Fabula (6.09 mg/cm^2), Red-scarlet (6.87 mg/cm^2), Julinka (8.12 mg/cm^2) and Viviana (8.65 mg/cm^2) sort samples differ according to the specific surface density of the leaves. It is recommended that these samples be used as primary donors for future selection which will be conducted according to the productivity and adaptability.

Keywords: Potato, photosynthetic indicators, sort samples, yield, ripeness

Introduction

In the direction of the priority 2.1, measure 7.2.12 of the "Strategic Roadmap for the production and processing of the agricultural products in the Azerbaijan Republic" which is approved by the decree President of the Republic of Azerbaijan dated December 6, 2016, the target is to increase the cultivated areas of potatoes to 64 thousand hectares and the production of potatoes to 1400 thousand tons in the republic [14].In order to achieve this target, it is of great importance to create or obtain the potato sorts with high yield and resistance to the major diseases, for our republic. In the republic, the planting and cultivation of the potato plant is mainly carried out in the irrigated lowland regions (and seed potatoes are mainly cultivated under conditions of the dry-farming land in the mountainous regions), the selection work should be directed towards the obtaining of the fast-growing potato sorts, too.Therefore, the object of the research was the early and medium-fast-growing, as well as the medium-growing potato sort samples.

It is known that 75-85% of the water and 15-25% of the dry matter accumulate in the potato tubers, depending on the soil-climate conditions. The dry matters contain 80-85% starch, 6.0-14% protein, 2-4.5% sugar, 40-120 mg/100g ascorbic acid, as well as alkaloids - solanine and chaconine [1, 2, 3,4, 6, 17, 18].

The studying of the physiological indicators in the selection of the potato plant and the selection of the primary donors on this basis are considered one of the most actual tasks in the modern age.Because the organic substances are collected in the process of photosynthesis occured in the leaves, they are also used as "building material" and energy source in the vital processes taking place in the plant organism. As a result of the photosynthesis, the biomass which is called the biological product in the plants, is created, and this also considered one of the main indicators of the productivity [5, 7, 11, 12, 14]. The leaves and the chlorophylls in them play an important role in the photosynthesis process. The studying of the specific surface density of the leaves, the collection of the leaf surface areas during the vegetation (photosynthetic potential - PP), the change of the total wet and dry biomasses on the sorts, which are considered the main indicators of the photosynthesis activity, are also is of exceptional importance in the selecting the valuable donors for the selectionists.

The evaluation of the potato genotypes of various origins according to some physiological parameters and the recommendation of the primary donors for the selectionists on this basis were the goal of the research.

Material and methods

As research material, the 20 potato sort samples taken and introduced from the gene pool of the Scientific-Research Institute on Vegetable Growing Scientific-Research Institute, were used.

The leaf surface area of the potato sort samples was appointed by L1-3000C portable apparatus, the amount of the chlorophyll in the leaves by SPAD-

502 Plus Chlorophyle meter device (by comparing the obtained numbers with the table attached to the device). The amount of the dry biomass and dry substance was determined according to A.I.Yermakov [15], the amount of the wet mass was determined with weighed on a chemical-technical scale.

The photosynthetic potential has been calculated with the summing of the leaf surface area during each day of the vegetation or with the multiplying the average leaf surface area (L_{av}) to the length of the vegetation period (T_v) by the following formula:

$$PP= L_{av} \cdot T_v \quad [4, 9]$$

The specific surface density of the leaves (SSDL) has been characterized with the amount of the dry leaf mass per unit leaf surface area and has been expressed with mg/cm^2 [9].

The results of the research were processed statistically and the correlation relations were determined among the various indicators [8, 13].

The planting of the potato sort samples was carried out with a 70x25 cm planting scheme on February 17 in 2016, on February 24 in 2017, and on February 26 in 2018-2019, and the appropriate phenological observations were implemented after planting.

Results and discussion

As a result of the conducted phenological observations, it was determined that the studied sort samples can be divided into three groups - fast-growing, medium-fast-growing and medium-growing groups according to their ripeness (the period from the mass output to the technical ripeness of the tubers). 4 samples (Viviana, Farida, Sifra, Telman) with a vegetation period of 89-91 days belong to the first group, 11 samples (Sevinj, Amiri-600, Captiva, Julinka, Colomba, Bellarosa, Irina, Fabula, Panomera, Red-scarlet , Silvana) (92-94 days) to the second group, and 5 samples (Mozart, Bermina, Elfe, Jelli, Concordia) (95-97 days) to the third group (Figure 1). But this division is conditional, it is justified only for the Absheron condition, in the other regions of the republic the ripeness of the samples may differ and they may pass from one group to another depending on the soil-climate conditions.

It was determined that the average leaf surface area of the researched sorts was 22.37±2.83 thousand m2/ha, and the photosynthetic potential was 1780±223.43 thousand m^2·day/ha, and the coefficient of variation of these indicators was 55.08 and was 54.71%, respectively. Such a high coefficient of variation allowed to choose the samples (the leaf surface area - 32.1-50.7 thousand m^2/ha and PP-2407-4003 thousand m^2·day/ha) differed according to the assimilation surface area and the photosynthetic potential of the planting with 95% probability among the researched samples. At this time, SID_{05} was 8.15 m^2/ha, and PP was 643.66 m^2·day/ha according to the leaf surface area. (Figures 2 and 3).

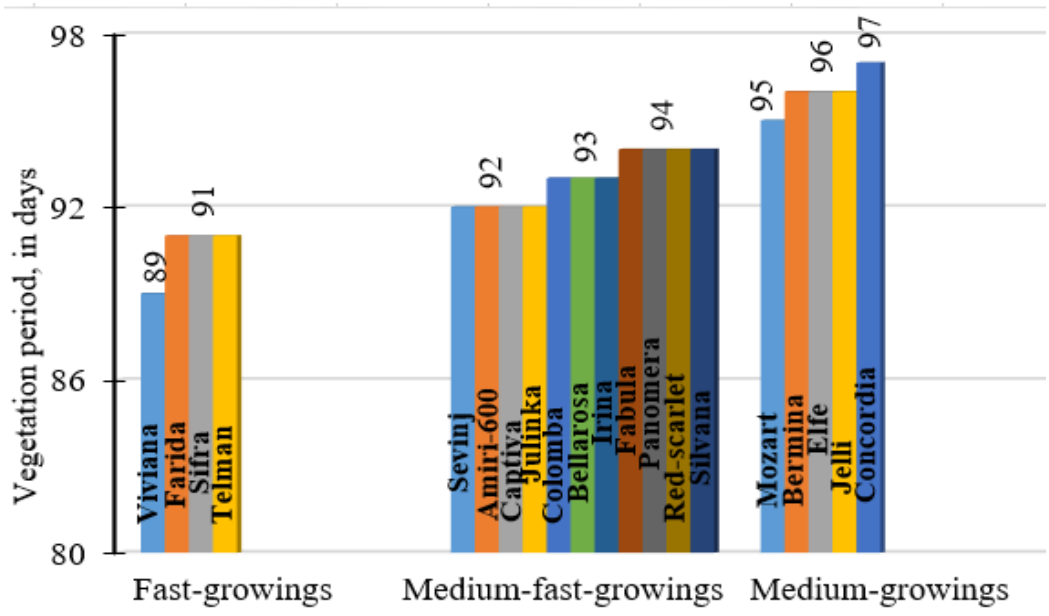

Figure 1. The grouping of the potato sort samples according to the ripeness (according to the average price for the years 2016-2018)

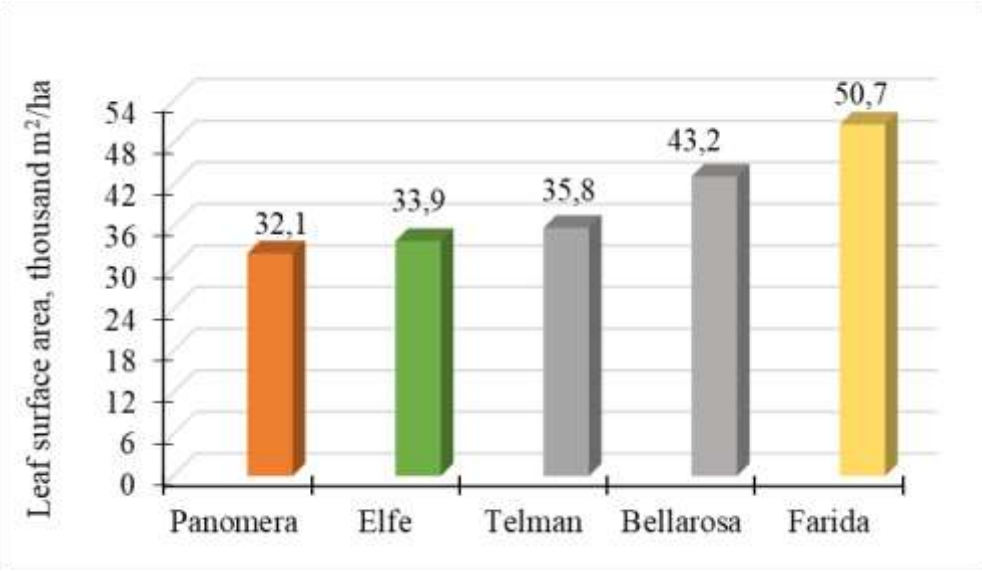

Figure 2. The potato sort samples differing according to the leaf surface area (average for the years 2017-2018, 32.1-50.7 m^2/ha)
SID_{05}=8.15 m^2/ha

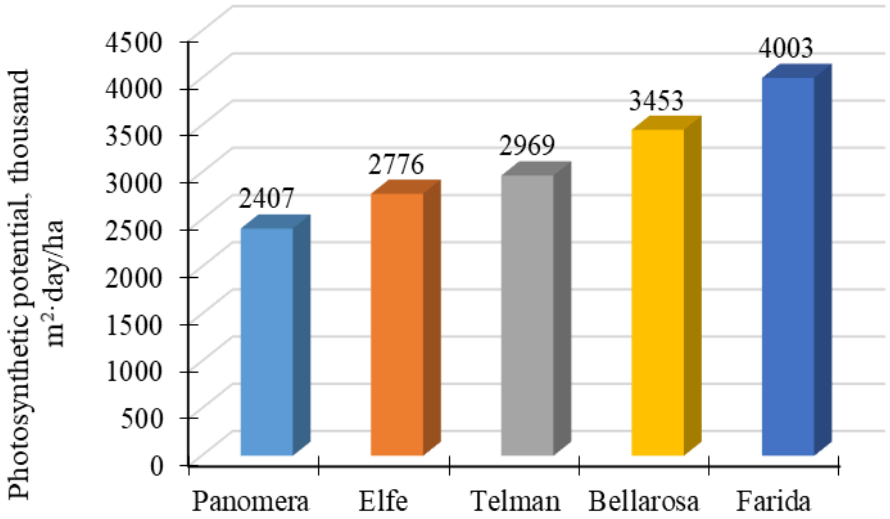

Figure 3. The potato sort samples differing according to the price of PP (average for the years 2017-2018,2407-4003 thousand m^2·day/ha)
SID_{05} – 643.66 m^2·day/ha

Since the amount of the chlorophyll in the leaves characterizes the power of the photosynthetic apparatus of the plant, the studying of this indicator is of great importance in terms of the potato selection. During the research years, the amount of the chlorophyll in the leaves varied on average in the range of 190.94±20.44 mg/100g wet mass, the coefficient of variation on the samples was 46.66%, and SID_{05} was 58.90 mg/100g or 30.85%. Such a changeability interval allowed to choose 6 samples - Telman (250.0), Sevinc (280.5), Elfe (296.5), Ponomera (332.0), Bellarosa (354.1) and Farida (357.9) differing with the amount of the chlorophyll (250.0-357.9 mg/100g) that they can be used as primary donors in future selection which will be conducted according to the productivity (Figure 4). It is interesting that these sort samples (with the exception of Sevinj, the leaf surface area was 30.2 thousand m^2/ha, and PP was 1778 thousand m^2·day/ha and did not differ from the other samples at the level of SID_{05} in this sort) also, from pictures 2 and 3 as can be seen, were differed with high values of the leaf surface area and PP, that is these samples can be used as very valuable primary materials in future selection of the potato which will be conducted according to the productivity.

During the research of SSDL, which is considered one of the important indicators of the photosynthesis and is significant importance in the assessment of the resistance of the plant to drought and heat, it was determined that Sifra (5.96), Fabula (6.09), Red-scarlet (6.87), Julinka (8.12) and Viviana (8.65) are distinguished with the highest price of SSDL (5.96-8.65 mg/cm^2, the average mathematical price on the samples was 4.40± 0.45, C_v= 44.34%. SID_{05}= 1.30 mg/cm^2 or 29.55%) (Figure 5). These sort samples can be very valuable samples

in the selection which will be conducted in future according to the adaptability and especially in the cultivation under conditions of the dry-farming land.

In the study, the amount of the total dry and wet biomass characterized the productivity of the plant was also appointed and it was shown that the amount of the total wet biomass on the collection samples was 186.95±12.34 cwt/ha, and the amount of the dry biomass was 25.91±1.78 cwt/ha. The coefficient of variation on these indicators was equal to 28.78 and 29.95%, and SID_{05} was 19.02 and 19.77%, respectively. Telman (32.6), Concordia (33.2), Elfe (33.0), Colomba (38.4) and Amiri-600 (39.8) sort samples were differed according to the amount of the total dry biomass (32.6-39.8 cwt/ha) at 95% probability level on the studied indicators. These sort samples (with the exception of Amiri-600, although the amount of the wet biomass in this sort is high enough - 211.6 cwt/ha, but this difference was not exact with 95% probability) are also characterized with the exact high amount of the total wet biomass (Telman - 225.6, Concordia 232.2, Elfe 260.4, Colomba 322.6 cwt/ha) (Figures 6 and 7).

It was also determined from the experiments carried out in the Absheron auxiliary experimental farm that the most of the studied potato sort samples (Figure 8) are characterized with the high amount of the commodity harvest (50-67.8%), and a small part of it with the high amount of the seed harvest (35.8-72.9%) (Figure 9). If the introduced sort samples (Red-scarlet - 57.6%, Silvana 58.7%, Concordia 61.9%, Irina 67.3%) prevail according to the amount of the commodity harvest, then the local sorts (Amiri- 600 53.5%, Sevinj 53.8%, Telman SID_{05} =58.9mg/100g 72.9%) dominate according to the amount of the seed harvest. It should be noted that the amount of the commodity and seed harvest can change depending on the general cultivation conditions. It is possible to increase the amount of the commodity harvest in the planting with the creating favorable conditions (the giving of the mineral and organic fertilizers, the increasing of the amount of the irrigations, the increasing of the number of the cultivation work, etc.).

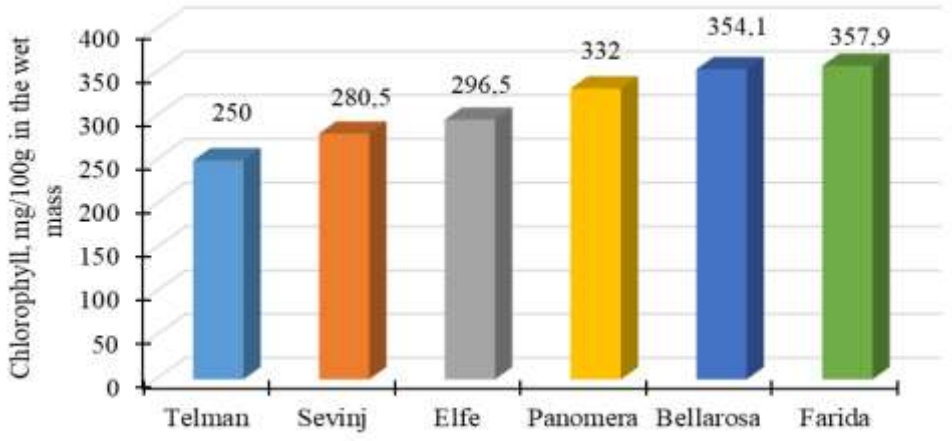

Figure 4. The potato sort samples differing with the amount of the chlorophyll in the leaves (average for the years 2017-2018, 250.0- 357.9 mg/100gin the wet mass)

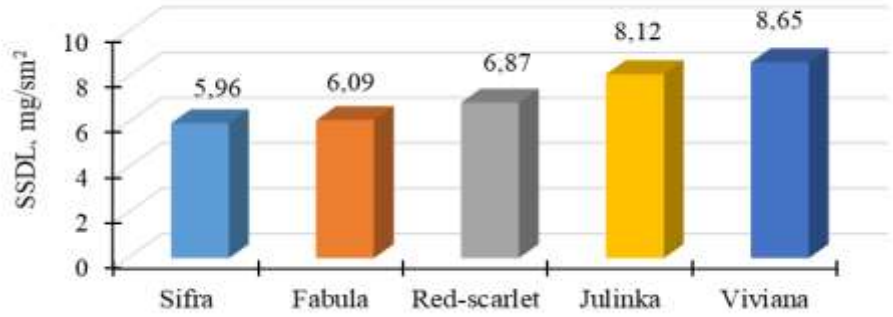

Figure 5. The potato sort samples differing with the highest price of SSDL (average for the years 2017-2018, 5.96-8.65 mg/sm^2)
ƏKMF$_{05}$ = 1.30mg/sm^2

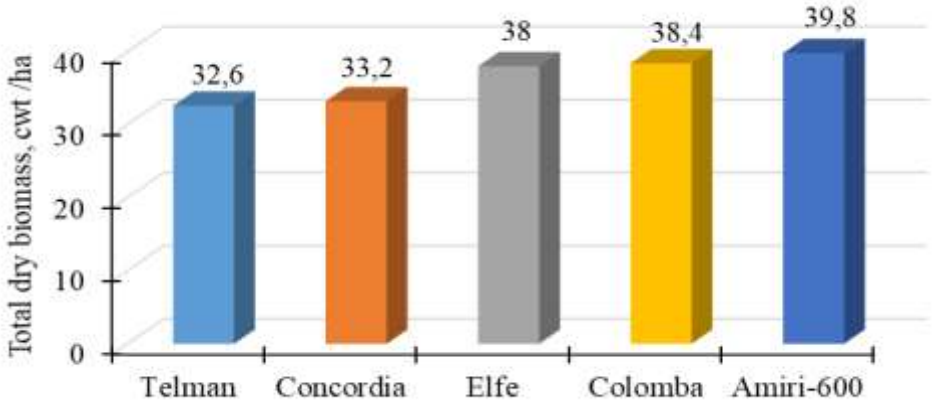

Figure 6. The potato sort samples differing with the high amount of the total dry biomass (average for the years 2017-2018, 32.6-39.8 cwt/ha)
SID$_{05}$=5.12 cwt/ha

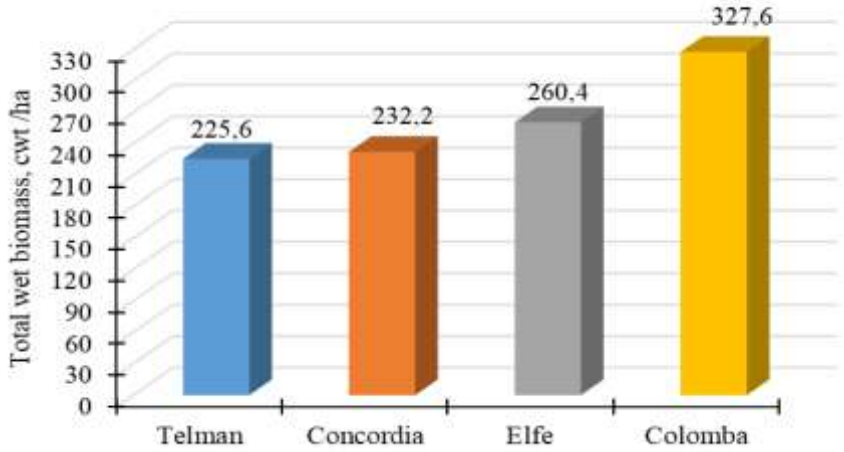

Figure 7. The potato sort samples differing with the high amount of the total wet biomass (average for the years 2017-2018, 225.6-327.6 cwt/ha)
ƏKMF$_{05}$ = 35.57 cwt/ha

The studied potato sort samples were divided into three groups according to their productivity. Group 1: the high-yielding sorts (466.0-619.7 cwt/ha). Panomera (466.0), Elfe (502.1), Julinka (560.0), Jelli (619.7 cwt/ha) sort samples include to this group; group 2: the medium-yielding sorts (273.3-424.0 cwt/ha). 9 sort samples include to this group: Concordia (273.3), Captiva (300.2), Farida (333.3), Sifra (335.7), Fabula (347.3), Viviana (367.3), Bellarosa (377.7), Mozart (414.7) and Colomba (424.0 cwt/ha); Group 3: the low-yielding sorts (224.3-252.0 cwt/ha): Irina (224.3), Bermina (227.0), Amiri-600 (227.3), Sevinj (229.3), Red-scarlet (238.7), Silvana (248.3) and Telman (252.0 cwt/ha) (Figure 10). The analysis of the statistical indicators on the productivity shows that the average mathematical price of the productivity on the collection samples was 348.6±27.7 cwt/ha, the coefficient of variation was 34.08%, and SID_{05} was 78.4 cwt/ha. As can be seen from the statistical data, the sorts differed with the high productivity indicator were distinguished exactly from the other sort samples (that is, their productivity was higher than 426.9 cwt/ha). This also proves the well adapting of these samples to the republic area. Exactly for this reason that the sort samples selected above according to their productivity, can be recommended for zoning in the Azerbaijan conditions. These samples can also be used as valuable donors in the selection which will be conducted in future on the productivity.

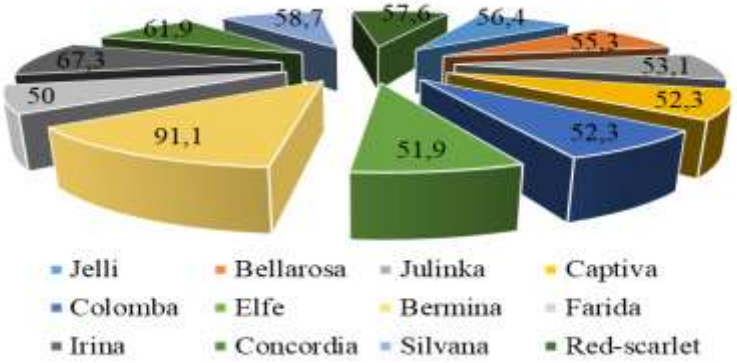

Figure 8. The potato sort samples differing according to the amount of the commodity harvest (average for the years 2016-2018, 50-67.3%)

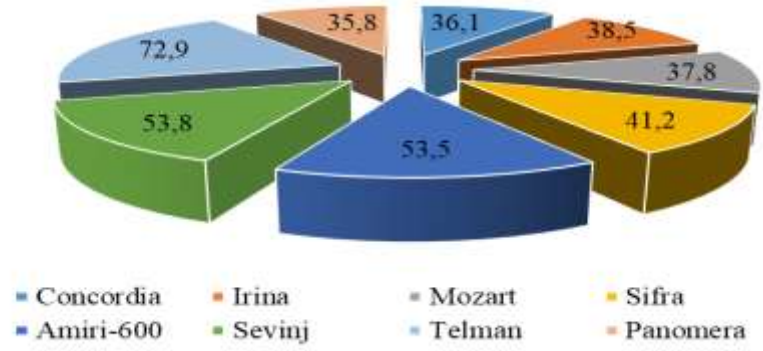

Figure 9. The potato sort samples differing according to the amount of the seed harvest (average for the years 2016-2018, 35.8-72.9%)

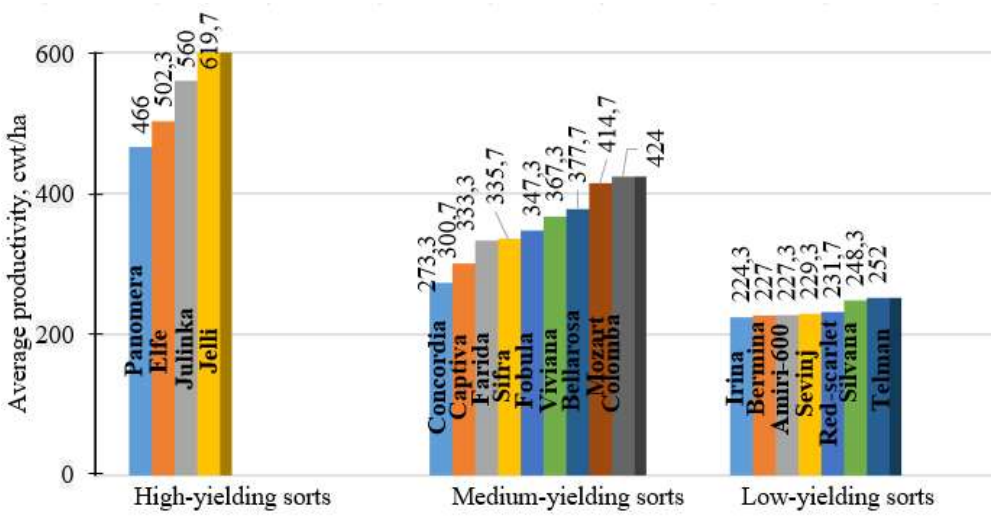

Figure 10. The grouping of the potato sort samples according to the productivity (average for the years 2016-2018)

$\bar{X} \pm 5\ \bar{X}$ = 348,6±27,2, C_V=94.08% SID_{05}=78.45 cwt/ha

Conclusion

So the results of the conducted research can be summarized as following:

1. The studied collection samples are divided into fast-growing (89-91 days), medium-fast-growing (92-94 days) and medium-growing (95-97 days) groups according to their ripeness, and into high-yielding (466.0-619.7 cwt/ha), medium-yielding (273.3-424.0 cwt/ha) and low-yielding (224.3-252.0 cwt/ha) sort samples according to their productivity.

2. Panomera (32.1 thousand m^2/ha, 2407 thousand m^2·day/ha and in 332.0 mg/100g wet mass, respectively), Elfe (33.9; 2776 and 280.5), Telman (35.8; 2969 and 250.0), Bellarosa (43.2; 3453 and 354.1), Farida (50.7; 4003 and 357.9) sort samples differ according to the leaf surface area, the photosynthetic potential of the plant, and the amount of the chlorophyll in the leaves that they can be used as valuable primary donors in future selection which will be conducted according to the productivity.

3. Sifra (5.96 mg/cm^2), Fabula (6.09 mg/cm^2), Red-scarlet (6.87 mg/cm^2), Julinka (8.12 mg/ cm^2) and Viviana (8.65 mg/cm^2) sort samples differing according to the specific surface density of the leaves (SSDL), are recommended to be used as primary donor samples in future selection which will be conducted according to the adaptability (the resistance to drought, heat, etc.).

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