Chlorophyll quantity in the leaves of sweet potato (Ipomoea batatas (L.) Lam.) in the condition of Uzbekistan

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ABSTRACT

The article revelas the results of the analysis of total chlorophyll, chlorophyll "a", chlorophyll "b" and carotenoids quantity in the leaves of sweet potato grown in local condition. In accordance to dispersion analysis of obtained data, the quantity of total chlorophyll, chlorophyll "a" and chlorophyll "b" of GulDU 1 and GulDU 2 varieties was in various levels respectively to Hazina, Hazina 1, Hazina 2 varieties. It has been determined from the results that the quantity of total chlorophyll, chlorophyll "a" and carotenoids in GulDU 2 variety was higher than in Hazina, Hazina 1, Hazina 2 and GulDU 1 varieties. It has been concluded that GulDU 2 variety is an effective for local condition and recommended to use it as valuable initial material in selection and breeding.

Keywords: *Ipomoea batatas (L.) Lam,* sweet potato, variety, total chlorophyll, chlorophyll "a", chlorophyll "b", carotenoid.

Introduction

Currently, when the world's population is growing, it is important to provide the population with ecologically safe and pure food products (Wang et al. 2016). In particular, in the agricultural sector of Uzbekistan, it is one of the most important issues in science and industry to cultivate high-yielding and best quality products that are resistant to diseases and pests (Jaloliddin et al. 2020).

In the world agriculture, sweet potato is being grown widely, because this plant is high-yielding, resistant to diseases, pests and adverse environmental conditions and contain high nutritional value. By its nutritional value and energetic calorie, sweet potato is 1,5 times superior to the common potato consumed widely (Harrison et al. 2003, Koala et al. 2013 and Ayeleso et al. 2018).

Being a new crop in Uzbekistan, sweet potato has been already recorded in the studies and research work of the world scientists, as they stated it is rich in protein, mineral salts, carbohydrates, many types of vitamins (B, PP, A), organic acids (ascorbic acid, folic acid), disaccharides and polysaccharides (Tang et al. 2016, Alam et al. 2016 and Ayeleso et al. 2018). Today, in order to create sweet potato varieties with high productivity and yield, it is required to study physiological-biochemical processes in the plant. Because the growth and development of the plant mostly depend on its physiological-biochemical features (He et al. 2015 and Ayeleso et al. 2018).

It has been stated that the process of photosynthesis in plants is important in the achievement of high productivity of plants (Jaloliddin et al. 2020). The decrease in photosynthesis is due to the main components of chloroplasts, which directly limit the photosynthetic potential of plants (Maisura et al. 2014). Chlorophyll is one of the main constituents of chloroplasts, and the chlorophyll “a” and “b” pigments in chlorophyll content are important in the process of photosynthesis,

which affects plant growth and development (Havaux M. 1998, Taiz and Zeiger 2006).

Therefore, the purpose of the experiment was to study the total amount of chlorophyll, chlorophyll "a", chlorophyll "b", carotenoids in the leaves of sweet potatoes which are grown locally.

Methods And Conditions Of Research

The experiment was carried out at the experimental field of the department of Biology of Gulistan State University, Gulistan, Uzbekistan during the months July-December, in 2018-2019 to evaluate the chlorophyll of five genotypes of sweet potato in acidic soil.

Five genotypes of sweet potato were used as experimental materials. Among these Hazina, Hazina 1, Hazina 2, GulDU 1, and GulDU 2 were collected from Gulistan State University, Gulistan, Uzbekistan. The experiment was laid out in a Randomized Complete Bock Design (RCBD) with three replications. The size of each plot was 2.5 x 1 m. Distances between two plots were 0.50 m and the blocks were 0.70 m apart. Planting distance between the rows was 60 cm and between plants was 30 cm, and planting of vine cutting on 16 April, 2018- 2019. The length of the vine cuttings ranges from 20-30 cm long with six to seven nodes. The plot were fertilized with a general dose of urea, Triple Super Phosphate (TSP), Muriate of Potash (MOP) as sources of nitrogen, phosphorus, potassium and were applied at 95, 105, 125 kg haG1, respectively.

The quantity of chlorophyll "a", chlorophyll "b" and carotenoids in the leaves of sweet potatoes was determined in the experiment. For this, samples were taken from 3-4 leaves of sweet potato growing in the field condition. Each leaf was placed in test-tube by 50 mg. Each leaf sample was homogenized in 5 ml of 100% acetone solution. The homogenate was centrifuged for 12 min at 5000 rpm. The light absorption of chlorophyll "a", chlorophyll "b" and carotenoids in the resulting extract was determined at 662, 645 and 470 nm (Agilent Cary 60 UV-Vis spectrophotometer). Based on this indicator, the quantity of chlorophyll “a”, chlorophyll “b” and carotenoids in the leaves of sweet potato was calculated using the equations of Lichtentaler and Wellburn (1985):

Chlorophyll “a” [mg/g] = $11.75 * A_{662} - 2.350 * A_{645}$

Chlorophyll “b” [mg/g] = $18.61 * A_{645} - 3.960 * A_{662}$

Carotenoid [mg/g] = $1000 * A_{470} - 2.270 *$ chlo “a” - $81.4 *$ chlo “b”/227

Statistic analysis of indicators of total chlorophyll, chlorophyll “a”, chlorophyll “b” and carotenoids was performed by the program Stat View 5.0 according to ANOVA in EXCEL 2016.

Results And Analysis Of Experiment

Dispersion analysis of the obtained results showed that the differences among the different quantities of total chlorophyll, chlorophyll “a”, chlorophyll “b” and carotenoids in the leaves of the plant varieties Hazina, Hazina 1, Hazina 2, GulDU 1 and GulDU 2 were assured. It was defined that chlorophyll “a” quantity ranged from 14 mg/g to 18 mg/g in the leaves of sweet potato. The highest indicator of chlorophyll “A” was noted in the variety GulDU 2 – 17,93 mg/g, while the lowest one was found in GulDU 1 variety, that is, it made 14,16 mg/g (fig.1). Chlorophyll “a” quantity indicator of GulDU 2 indicated confident differences from the quantity indicators of chlorophyll “a” in the varieties Hazina, Hazina 1, Hazina 2 and GulDU 1, while Hazina variety was also differentiated from chlorophyll “a” quantity indicators of Hazina 1, Hazina 2 and GulDU 1 varieties.

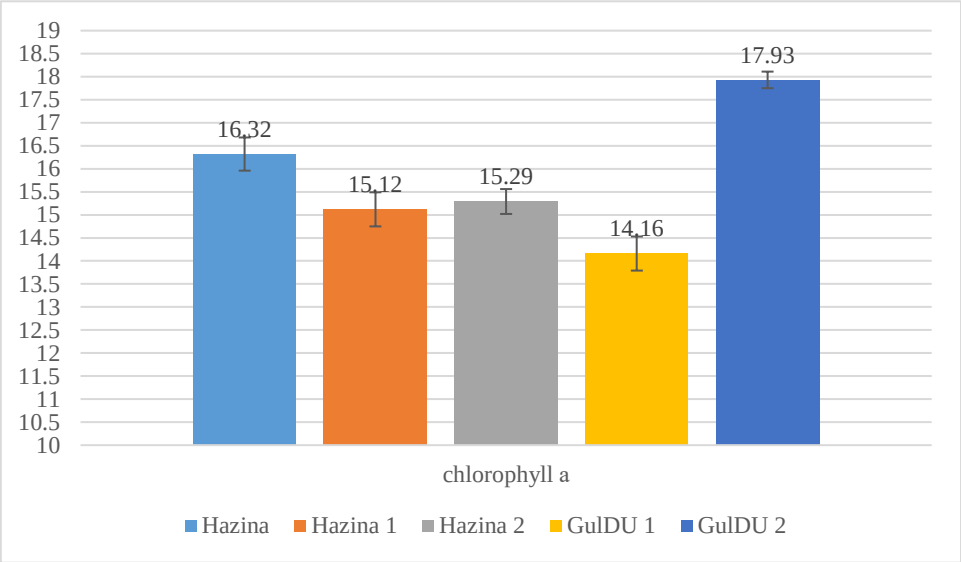

Figure-1. Chlorophyll "a" quantity indicators in the leaves of sweet potato in local condition

Chlorophyll "b" quantity was found to be 4,5 mg/g – 6,1mg/g in the leaves of sweet potato. The highest indicator of chlorophyll "b" was observed in Hazina 2 variety – 6,12 mg/g, while the lowest indicator of chlorophyll "b" quantity was noted in GulDU 1 variety, 4,58 mg/g (fig.2).

In the experiment it was identified that the difference of higher indicator of chlorophyll "b" quantity in sweet potato varieties Hazina, Hazina 1 and Hazina 2 from GulDU 1 and GulDU 2 varieties was confidential and substantiated.

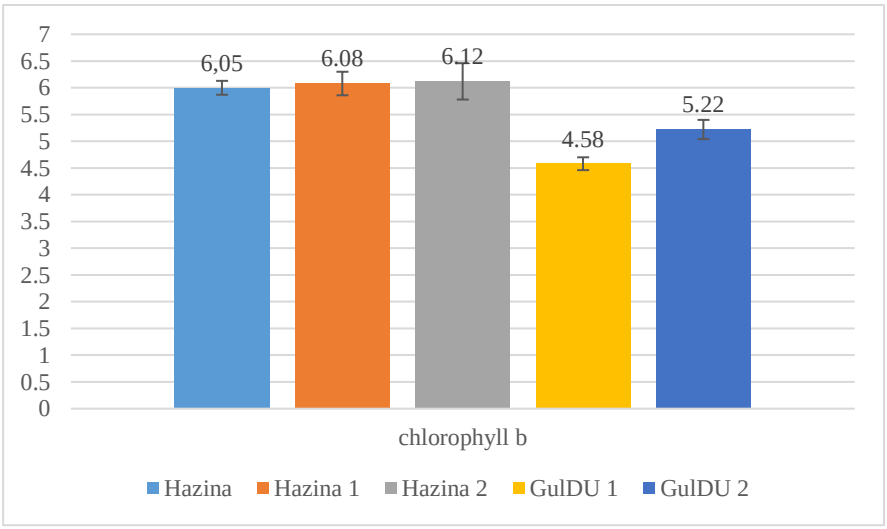

Figure -2. Chlorophyll "b" quantity indicators in the leaves of sweet potato in local condition

Total chlorophyll quantity was found to be 18,7 mg/g - 23,2 mg/g in the leaves of sweet potato. The lowest indicator of the quantity of total chlorophyll was in GulDU 1 variety, that is, 18,74 mg/g, while the highest one was noted in GulDU 2 variety – 23,16 mg/g (fig.3). Confidential difference of Hazina, Hazina 1 and Hazina 2 varieties from GulDU 1 variety, difference of GulDU 2 variety from Hazina, Hazina 1, Hazina 2 and GulDU 1 varieties by their total chlorophyll quantity indicators was determined. Total chlorophyll quantity indicator of GulDU 2 variety was found to be higher in the experiment than the total chlorophyll amount of Hazina, Hazina 1, Hazina 2 and GulDU 1 varieties.

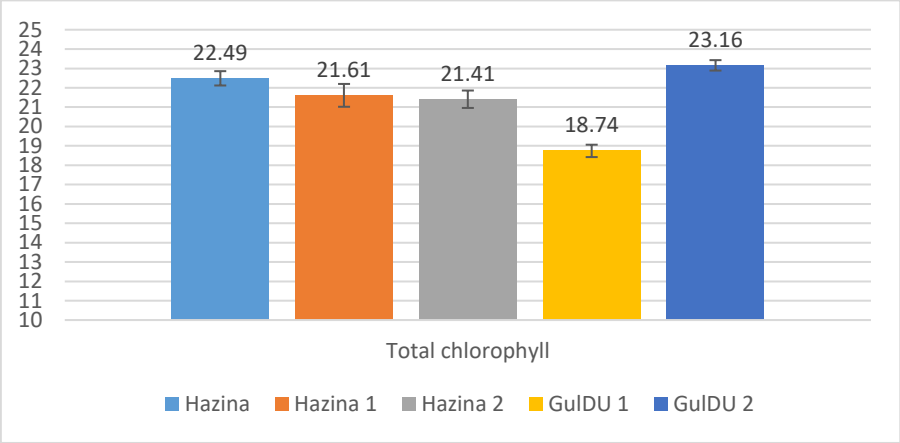

Figure-3. Total chlorophyll quantity indicators in the leaves of sweet potato in local condition

Carotenoid amount in sweet potato varieties was the highest in GulDU 2 variety, 5,04 mg/g, while the lowest indicator of this amount was noted in Hazina 2 and GulDU 1 varieties (3,72 mg/g and 3,77 mg/g respectively) (fig.4). By the quantity indicator of carotenoids, a confidential difference was identified between GulDU 2 variety and Hazina, Hazina 1, Hazina 2, GulDU 1 varieties, also between Hazina, Hazina 1 varieties and Hazina 2, GulDU 1 varieties. In the experiment it was found out that the quantity of carotenoids was more in GulDU 2 variety of sweet potato than in Hazina, Hazina 1, Hazina 2 and GulDU 1 varieites.

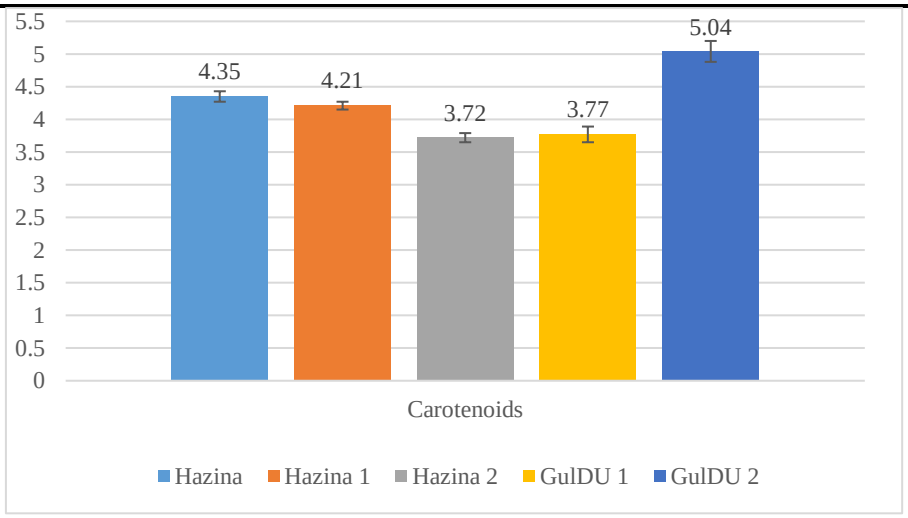

Figure-4. Carotenoid quantity indicators in the leaves of sweet potato in local condition

During the experiment it was revealed that total chlorophyll, chlorophyll "a", chlorophyll "b" quantities in the leaves of sweet potato were closer to each other in Hazina, Hazina 1 and Hazina 2 varieties. In GulDU 1 and GulDU 2 varieties this indicator was sharply differentiated. Carotenoid quantity indicators were close to each other in Hazina and Hazina1 varieties, and also in Hazina 2 and GulDU 1 varieties. While in GulDU 2 variety this indicator was highly different. Chlorophyll pigments are very important in the process photosynthesis, and they are positively connected with the growth, development and fertility of the plant (Wang et al. 2016 and Jaloliddin et al. 2020). Therefore, GulDU 2 variety is regarded the most effective one for agriculture sector.

Conclusion

It can be concluded from the experiment results that the quantity of total chlorophyll, chlorophyll "a" and carotenoids was higher in GulDU 2, Hazina, Hazina 1, Hazina 2 and GulDU 1 varieties. In GulDU 1 and GulDU 2 varieties the quantities of total chlorophyll, chlorophyll "a" and chlorophyll "b" were in different levels compared to Hazina, Hazina 1, Hazina 2 varieties.

During the experiment it was determined that the quantities of total chlorophyll, chlorophyll "a", chlorophyll "b" and carotenoids in sweet potato plant were more in GulDU 2 variety compared to Hazina, Hazina 1, Hazina 2 and GulDU 1 varieties. GulDU 2 variety was found to be effective crop for local regions and valuable initial material to be used in selection-breeding work.

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