Advanced Studies in Biology, Vol. 17, 2025, no. 1, 1 - 10
HIKARI Ltd, www.m-hikari.com
https://doi.org/10.12988/asb.2025.91968

The Correlation Between Important Farm Indicators in Potato (*Solanum tuberosum* L.), Eggplant (*Solanum melongena* L.) Samples

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Abstract

The article indicates the correlation relations between different important farm indicators of the potato and eggplant sort samples of different geographical origin. The leaf surface area, the amount of the chlorophyll in the leaves, the dry biomass and dry substance were determined in the potato and eggplant sort samples. The correlation relations between various important farm indicators of 20 potato (*Solanum tuberosum* L.) and 59 eggplant (*Solanum melongena* L.) collection samples cultivated in the Absheron auxiliary experimental farm of the Vegetable Scientific-Research Institute were studied and it was shown that there are exact relations which are the dense according to the Cheddock scale at the $p \geq 0.05\%$ level between these indicators. In potato, the relations between leaf surface area–PP (0.922), leaf surface area–chlorophyll (0.911), leaf surface area–productivity (0.672), chlorophyll–PP (0.872), PP–productivity (0.611), chlorophyll-SSDL (-0.812), PP-SSDL (-0.818), leaf surface area-SSDL (-0.829), and in eggplant, (0.442-0.838) - leaf surface area-PP (0.838), leafsurface area-wet biomass (0.672), leaf surface area-dry biomass (0.612), PP-productivity (0.465), PP-wet biomass (0.455) and leaf surface area-productivity (0.442) can be belonged such relations (0.611-0.922) that can be used successfully in the selection which will be carried out in future according to the productivity, quality and adaptability.

Keywords: Collection samples, Correlation relations, Eggplant, Physiological and Biochemical indicators, Potato

Introduction

It is known that the relations detected with the phenotypic correlation are used widely during the selection of the potato and eggplant sorts in the selection process [2, 4]. The scientists of many countries have researched the plant sorts of different geographical origin (especially the cereal) in order to detect the correlation relations between various important farm indicators in the selection carried out according to quality, productivity and adaptability, and obtained successful results [5, 16, 9].

The Cheddock scale is used for to evaluate the linear correlation coefficient between various important farm indicators of the agricultural plants, and for to determine its multiple index or the statistical dependence of the quantitative indicators on the qualitative indicators [12-13]. The Cheddock scale is a ratio between accidental factors and variables, which allows to convert the quantitative characteristics of the objects to a relatively accurate numerical price. The Cheddock scale provides for to evalute the relation density or the mutual influence of the variable quantities.

The quantitative and qualitative characteristics of the relation density according to the Cheddock scale are as following [13]:

The quantitative measure of the relation density	**The qualitative characteristic of the relation power**
0.1-0.3	weak
0.3-0.5	medium
0.5-0.7	noticeable
0.7-0.9	high
0.9-0.99	very high

The purpose of the research was to detect the correlation relations between different important farm indicators of the potato and eggplant sort samples of different geographical origin and to give the recommendations for using of them in the selection which will be conducted according to the productivity, quality and adaptability.

Materials and methods

20 potato and 59 eggplant collection samples of different geographical origins cultivated in 2000 in the Absheron auxiliary experimental farm of the Vegetable Scientific-Research Institute Public Legal Entity served as the research material.

The leaf surface area in the potato and eggplant 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 were determined according to A.I.Yermakov [13], the amount of the wet mass was determined with weighed on a chemical-technical scale.

The photosynthetic potential (PP) 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 [1, 8]:

$$PP = L_{av} \cdot T_v$$

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 [1]. The farm efficiency coefficient of the photosynthesis (FECP) was evaluted as the ratio of the mass of the farm important part of the plant (a root in potato, a fruit in eggplant) to the mass of the above-ground part of the plant (leaves, stems and stalks, flowers) [8].

Results and discussion

The correlation relations between various important farm indicators of the potato sort samples. The results of the correlation analysis conducted on 20 sort samples of different geographical origins of the potato showed that the correlation relations were of different levels between different physiological and biochemical indicators (Fig. 1).

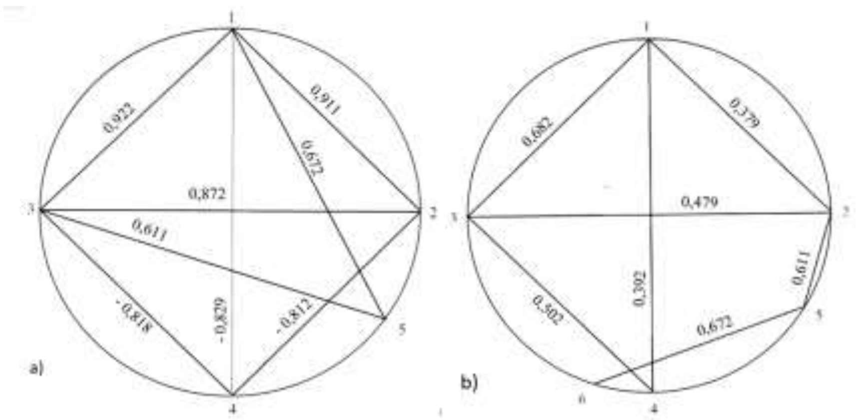
The correlation relations were researched among 24 indicators – leaf surface area-chlorophyll, leaf surface area-productivity, chlorophyll-productivity, chlorophyll-photosynthetic potential (PP), productivity-PP, wet biomass-chlorophyll, dry biomass-chlorophyll, dry biomass-PP, wet biomass-PP, starch-wet biomass, starch-dry biomass, the mass of the above-ground part-the mass of the tubers, SSDL-leaf surface area, SSDL-PP, SSDL-total dry biomass, SSDL-total wet biomass, SSDL-FECP (the farm efficiency coefficient of the photosynthesis), dry substance-nitrates, dry substance-PP, dry substance-productivity, nitrates-starch, nitrates-PP, nitrates-productivity on the studied samples and it was determined that the relation between some of these indicators was exact at the level of $p \geq 0.05$ and was high, in some it was at an average level, in some it was very small and was not statistically significant.

As can be seen from the reflected data in figure 1, the correlation coefficient is high and very high between leaf surface area-chlorophyll, leaf surface area-PP, leaf surface area-productivity, chlorophyll-PP, PP-productivity, the relation between these signs is very dense directly according to the Cheddock scale, is 0.911; 0.922; 0.672; 0.872; 0.611, respectively (Fig. 1a).

The correlation relations of relatively moderate level (the moderate and noticeable according to the Cheddock scale) were reflected in Figure 1b. These relations also, in our opinion, can be great importance in the selection of potato.

All of these relations (dry biomass-PP 0.379, $p \geq 0.5\%$; dry biomass-chlorophyll 0.392, $p \geq 0.05\%$; total wet biomass-PP 0.479, $p \geq 0.05\%$; wet biomass-chlorophyll 0.502, $p \geq 0.05\%$; PP-productivity 0.611, $p \geq 0.05\%$; productivity-FECP 0.672, $p \geq 0.05\%$) are medium and noticeable dense directly according to the Cheddock scale.

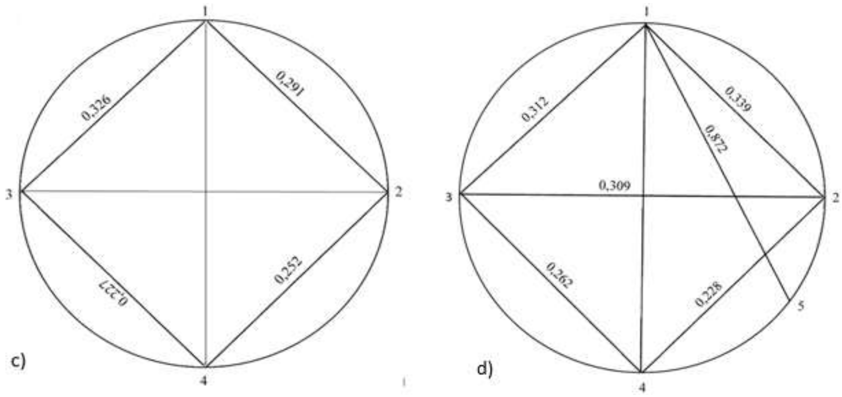
The correlation relations (except for the relation between dry substance and total dry biomass, this relation is high according to the Cheddock scale, is 0.872) which are not exact at the $p \geq 0.05$ level are reflected in Figure 2. The starch-wet biomass (0.291), wet biomass-SSDL (0.252), dry biomass-SSDL (0.227), starch-dry biomass (although 0.326 is belonged to the medium grade correlation according to this scale) correlation relations belong to these relations. These relations can be used in the selection carried out according to the quality. The same type of moderate level relations were detected between dry substance-nitrates (0.339), nitrates-starch (0.309), dry substance-starch (0.312), and the weak correlations between starch-PP (0.262), nitrates-PP (0.228). According to the data given in the literature, it is possible to increase the relations between dry substance and various indicators with giving the organic and mineral fertilizers in different doses, as well as growth substances in the form of nutrition off the root under the potato plant, and they can be used successfully in selection carried out according to the quality [6-7, 11].



P≥0.05 P≥0.05

Figure 1. The correlation relations between different physiological indicators in the potato sort samples

a) 1-ASL; 2-Chlorophyll; 3-PP; 4-SSDL; 5-Productivity.
b) 1-Dry biomass; 2-PP; 3-Wet biomass; 4-Chlorophyll; 5-Productivity; 6-FECP.



P≥0,05 P≥0,05

Figure 2. The correlation relations between different physiological and biochemical indicators in the potato sort samples

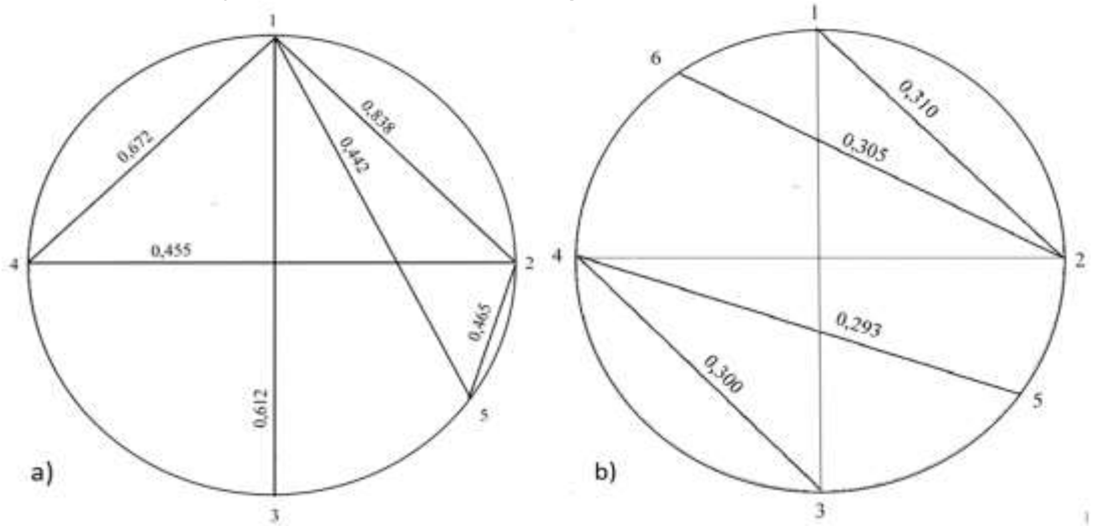
Note: c) 1-Starch; 2-Wet biomass; 3-Dry biomass; 4-SSDL.
d) 1-Dry substance; 2-Nitrates; 3-Starch; 4-PP; 5-Dry biomass.

So the studying of the correlation relations between different physiological and biochemical indicators of the potato sort samples showed that there are high negative correlation relations between some physiological indicators. The correlation relations between chlorophyll-SSDL (-0.812), leaf surface area-SSDL (-0.829), PP-SSDL (-818) are of great interest. The detecting of these negative relations is natural actually, because all of these indicators are related directly with the leaf surface area. Since SSDL is proportional inversely to the leaf surface area (SSDL-M_d/L_{av} - M_d is the dry biomass of the leaves, L_{av} is the average leaf surface area of one plant), the amount of the chlorophyll in the leaves and the price of the photosynthetic potential are conditioned directly with the leaf surface area, that is why these correlation relations can be used successfully in the selection carried out on the adaptability, ie, it may be to increase the photosynthetic ability, the resistance to heat and drought of the plant, with the reducing SSDL.

The correlation relations between various important farm indicators of the eggplant sort samples. The correlation relations were studied between various physiological and biochemical indicators also in the eggplant sort samples as in the potato sort samples.The correlation analysis of the results of the research conducted on 59 samples showed that the high correlation relations at the $p \geq 0.05\%$ level and direct according to the Cheddock scale is observed between leaf surface area-PP (0.838), leaf surface area-wet biomass (0.672), leaf surface area-dry biomass (0.612), PP-productivity (0.465), leaf surface area-productivity (0.442), PP-wet biomass (0.455) (Fig. 3).These relations can be used in the selection conducted according to the productivity. That is, it is possible to increase both photosynthetic potential, total wet and dry biomasses, and productivity in eggplants by increasing the leave surface area in eggplant through various agrotechnical measures (irrigation, the nutrition with and off the root, bottom filling, cultivation, weeding in time, etc.).The correlation coefficients (0.293-0.310) at the level of P≥0.05% and relatively low level according to the Cheddock scale, but considered direct were reflected in Figure 3b.

The correlation relations between leaf surface area-chlorophyll (0.310), chlorophyll-PP (0.305), productivity-dry substance (0.300), productivit-wet biomass (0.293) can be belonged to these relations, the other studied correlation relations were at the p≥0.05% level and weak according to the Cheddock scale, and were not statistical significant. The relatively highest relation in these relations was noted between nitrates-PP (0.272) that was also not statistical significant (Table 1).

In our research, a negative price of the correlation coefficient (-0.147) was noted between dry substance and PP, although it was weak, ei, the increase of PP,



P≥0,05 P≥0,05

Figure 3. The correlation relations between some physiological and biochemical indicators in the eggplant collection samples (The correlation relations at the p≥0.05% level and direct according to the Cheddock scale)

e: a) 1-Leaf surface area; 2-PP; 3-Dry biomass; 4-Wet biomass; 5- Productivity. b) 1-Leaf surface area; 2-Chlorophyll; 3-Dry substance; 4-Productivity; 5-Wet biomass; 6-PP.

as well as the leaf surface area, which is proportional directly to it, cause to the decrease of the amount of the dry substance in the vegetative and generative organs of the plant.This relation shows again that the leaf surface area can be increased to a certain limit in the plantings. The literature data also show that, in the eggplant plantings, the development of the plant becomes more normal, and it becomes possible to get quality and high harvest from it, when the leaf surface area is 40-50 thousand m^2/ha [6-7, 10]. The second relatively weak price of the correlation coefficient was noted between chlorophyll-productivity (0.218). According to many authors, in the plants, the amount of the chlorophyll conditions the power of their photosynthetic apparatus, ei, how much the amount of the chlorophyll will be more higher in the leaves of the plants, then the photosynthetic apparatus will be works so strongly in the plant, the growth of the plant will be faster and the harvest will be higher [14-15, 17]. But in our experiments, neither in potato nor eggplant samples, the high correlation relations between these indicators were not detected. In the potato samples, the price of this relation was lower, it was 0.032. It seems that the correlation relation determined for cereals and melons (watermelon) cannot be applied to the plants from *Solanaceae* family.That is, the correlation relation between chlorophyll-productivity is a specific characteristic for wheat and watermelon, conditions with their genotypes directly.

So the results of the correlation relations of the physiological and biochemical indicators obtained on 59 samples of eggplant showed that at the $p \geq 0.05\%$ level, there are relatively dense relation (0.442-0.838) according to the Cheddock scale between correlation relations of leaf surface area-PP (0.838), leaf surface area-wet biomass (0.672), leaf surface area-dry biomass (0.612), PP-productivity (0.465), PP-wet biomass (0.455) and leaf surface area-productivity (0.442).The correlation relations with the relatively low price (0.293–0.310), direct according to the Cheddock scale and at the $p \geq 0.05\%$ level were noted between leaf surface area–chlorophyll (0.310), chlorophyll–PP (0.305), productivity–wet biomass (0.293), and productivity–dry substance (0.300). The correlation relations noted between the other indicators were very small (-0.147-0.272), and were not considered direct according to the Cheddock scale, at the $p \geq 0.05\%$ level.

The highest price of the correlation coefficient (0.611-0.822, dense according to the Cheddock scale at the $p \geq 0.05\%$ level) between various important farm indicators of the potato collection samples is noted between leaf surface area-chlorophyll (0.911), leaf surface area-photosynthetic potential (0.922), chlorophyll-photosynthetic potential (0.872), leaf surface area-productivity (0.672), photosynthetic potential-productivity (0.611), chlorophyll-SSDL (-0.812), photosynthetic potential-SSDL (-0.818) and leaf surface area-SSDL (-0.829) that this can be used widely in the selection carried out according to the productivity.At the same time, the other correlation relations (dry biomass-wet biomass (0.682), productivity-farm efficiency coefficient of the photosynthesis (0.672), photosynthetic potential-productivity (0.611), photosynthetic potential-wet biomass (0.479), dry biomass-chlorophyll (0.397) and dry biomass-photosynthetic potential (0.379)) considered direct according to the Cheddock scale at the $p \geq 0.05\%$ level (0.379-0.682) were also detected.

Table 1. The correlation relations between various important farm indicators of the eggplant collection samples(n=59)

№	Physiological and biochemical indicators	Physiological and biochemical indicators							
		Leaf surface area	**Chlorophyll**	**PP**	**Productivity**	**Dry biomass**	**Wet biomass**	**Dry substance**	**Nitrates**
1	Leaf surface area, thousand m^2/ha	\\\\\\	0.310	0.838	0.442	0.612	0.672	_	_
2	The amount of the chlorophyll in the leaves, mg/100 gin the wet mass	0.310	\\\\\\	0.305	0.218	0.109	0.104	_	_
3	PP, thousand m^2/ha·day	0.838	_	\\\\\\	0.465	0.150	0.455	-0.147	0.272
4	Productivity, cwt/ha	0.442	0.218	0.465	\\\\\\	0.071	0.293	0.300	0.112
5	Dry biomass, cwt/ha	0.612	0.109	0.150	0.071	\\\\\\\	0.175	0.443	_
6	Wet biomass, cwt/ha	0.672	0.104	0.455	0.293	0.175	\\\\\\	0.099	0.072
7	Dry substance, %	–	–	-0.147	0.300	0.443	0.099	\\\\\\\\	–
8	Nitrates, mg/kg	_	_	0.272	0.112	_	0.072	_	\\\\\\

The price of the correlation coefficient direct according to the Cheddock scale at the p≥0.05% level, between some physiological and biochemical indicators of 59 eggplant collection samples, varies in the interval of 0.442-0.838.The correlation relations between leaf surface area-photosynthetic potential

(0.838), leaf surface area-wet biomass (0.672), leaf surface area-dry biomass (0.612), photosynthetic potential-productivity (0.465), photosynthetic potential-wet biomass (0.455) and leaf surface area-productivity (0.442) are belonged such relations, and these relations can be used successfully in the selection will be carried out according to the productivity in future.

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Received: December 15, 2024; Published: January 7, 2025