Studying the crop yield influence on the commercial quality of the promising table grapes

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Abstract. The article contains an introduction, general research objectives are indicated, a comprehensive solution for evaluating raw materials for industrial processing for various types of food products is presented, 18 promising table grape varieties are studied as well as their yield and commercial quality, the percentage of non-standard products is determined, and mathematical processing of data is carried out. Correlation and regression analysis showed that the relationship between yield and yield of marketable grapes is reliable and strong, and the form of correlation is direct \((r = 0.99)\). The indicated dependence is described by the equation \(y = 0.937x - 1.2139\). The regression coefficient by \(x = 0.937\) shows in which direction and how the function \((y)\) changes on average when the argument \((x)\) changes. Using the obtained equations, it is possible to construct a theoretical line of regression, according to which it is possible to predict the value of marketable grapes from yield. An increase in the yield of grapes for every 10 centners per hectare leads to an increase in the yield of marketable grapes by 9.37%.

1. Introduction

A priority of the State Policy in every developed country is a healthy nation by providing food security and healthy food.

Lately there has been an uptrend in Russia for foreign products, which do not always meet the requirements of the food security and contain chemical and biological xenobiotics.

Besides, one more peculiarity of nutrition nowadays is hard technological treatment of products consumed, which destroys or significantly lowers the amount of biologically active nutrients: vitamins, mineral substances, amino acids, and other nutrients, important for metabolic processes in a human body.

According to the Institute of Nutrition RAMS most of Russian population has a disbalanced nutrition with insufficient consumption of nutrient stuff and the disturbance of their dietary condition, that is deficiency of vegetable oil consumption, polyunsaturated fatty acids, phosphoptides, native proteins, including vegetable ones, most vitamins and first of all, antioxidant vitamins C, E, provitamins, mineral substances – potassium, calcium, magnesium, zinc, fluorine, iodine and others, as well as the deficit of polysaccharide dietary fibers – pectin, cellulose and digestible sugars – glucose and fruit sugar.
In order to fulfill the State Politics Conception in the sphere of healthy nutrition for the population in Russia till 2025 the South region of the country has a great potential including raw material and industrial base for the production of ecologically pure products of high nutrient and biological quality as well as vegetable biologically active additives.

A great contribution to the processing technology of plant raw material for the production of high quality and high nutrition product meeting the world standards, including functionality was done by V.M. Pozdnyakov, L.G. Eliseeva, A.P. Nechaeva, A.U. Shazo, A.T. Markha, A.F. Fan-Ung, B.L. Flaumenbaum, G.I. Kasianov, G.M. Zaiko, B.A. Tutelian and other scientists.

One of the important features of the well-balanced diet is daily consumption of vegetables. Grapes take a special place here as they have valuable nutritious, dietary and health-promoting effects.

Figure 1. Stages of integrated raw material assessment

According to the Institute of Nutrition RAMS, grapes is a necessary component of nutrition, “fruit, berries and grapes should make 100 kg per year in the physiologically grounded food standard per capita, not less than 10 kg of fresh grapes per capita”.

Republic of Dagestan is a special zone in the RF with the most favorable soil-climate conditions for the commercial production of the table grapes, besides it has highly productive varieties and long term experience of the Caucasus population. The biggest vineals are in Derbent, Kajakent, Karabudakhkent and Khasavurtov regions, and the greatest gardening regions are along the river valleys Samur, Gulgerychay and four Koisu. Grapes growing in Dagestan, being the leading in the Russian Federation will remain one of the most important branches of the agriculture production.

Production run is increasing gradually in Dagestan processing industry. Nowadays, the food processing industry in Republic of Dagestan includes 427 registered enterprises of all forms of the ownership. They include 68 big and middle-sized enterprises.

Plant capacity of food processing industry is used by 15–20 per cent, though; the enterprises have rather big annual production capacities.

The potential of the food and processing enterprises, as well as the sufficient raw material base for fruit-berry and grapes production in Dagestan make possible to process these goods.

That is why, theoretical grounding and practical application of the provision system with biologically...
valuable and ecologically pure organic food on the basis of the local raw material, developing new recipes and technological solutions guaranteeing native physiological value of raw material components, grounding the introduction of substances with vitamin and antioxidant activity into the products, optimization of the composition of the functional products, resources – efficient technologies are an important study today.

The purpose of the study is to develop a complex system of food provision for the population. The food with high nutritious quality based on the local raw material should meet contemporary requirements of the nutritional science based on complex estimation of table grape varieties and fruit-berry production, technological improvement of the production, creating new functional products and biologically active additives, as well as introduction of resource saving technologies of processing secondary raw material resources.

This issue has been studied by the professors and post-graduate students of the Merchandizing, Food technology and Public Catering Board in Dagestan SAU since 2002.

2. Results and discussion

The first stage in developing the system of providing population with biologically valuable products is complex estimation of the raw material quality (fig. 1) in order to recommend rational utilization for processing. For this, consumer properties, market quality, structural-mechanic and biochemical composition have been studied in order to determine the safety parameters of the fruit-berry raw material.

The data on the crop yield and grape commercial quality are in fig. 2 and table 3. The varieties under study differ in yield and marketable grape output per area unit. The greatest crop yield is for the varieties Izabella, Rizamat and Pamyati Negrulia whose crop yield per a bush is 12.2, 11.1 and 10.2 kg per a bush, and per 1ha – 203.3, 186 and 170 centner. The least crop yield is for Muskat Gamburgskii – 6.9 kg per a bush (115 c/ha), Nimrang – 7.7 kg per a bush (128 c/ha) and Taify Pink – 7.6 kg per a bush (126 c/ha). The yield in Agadai is 132 c/ha, Smuglyanka Moldavskaya is 137 c/ha, Moldova is 138 c/ha, Kosmonavt – 140 c/ha, Kishmish White is 142, Kutuzovskii is 145 c/ha, Kishmish black is 153 c/ha, Dekabrskii is 155 c/ha, Pamiati Verderevskogo is158 c/ha.

![Figure 2. Crop yield of the grape varieties under study](image-url)
Table 1. Crop yield and grapes quality

| No.  | Variety              | Crop yield kg. per a bush | Marketable grapes output % |
|------|----------------------|---------------------------|-----------------------------|
|      |                      | c/ ha                     |                             |
| Agadai, | 7.9                  | 132                       | 125.1                       | 94.8 |
| Guliabi Dagestanskii | 7.6                  | 126.6                     | 113.9                       | 90.1 |
| Dekabrskii | 9.3                  | 155                       | 141.4                       | 91.2 |
| Izabella | 12.2                 | 203.3                     | 185.8                       | 91.4 |
| Kantemirovskii | 8.2                  | 137                       | 126.7                       | 92.5 |
| Kishmish White | 8.5                  | 142                       | 128.9                       | 90.8 |
| Kishmish Black | 9.2                  | 153                       | 138.5                       | 90.5 |
| Kosmonavt | 8.4                  | 140                       | 130.5                       | 93.2 |
| Kutuzovskii | 8.7                  | 145                       | 135.1                       | 93.2 |
| Moldova | 8.2                  | 138                       | 130.1                       | 94.3 |
| Muskat Derbentskii | 6.8                  | 113.2                     | 103.4                       | 91.3 |
| Muskat Gamburgskii | 6.9                  | 115                       | 104.8                       | 91.1 |
| Nimrang | 7.7                  | 128                       | 121.5                       | 94.9 |
| Pamiaty Ver derevskogo | 9.5                | 158                       | 148.0                       | 93.7 |
| Pamiaty Negru lia | 10.2                 | 170                       | 159.6                       | 93.9 |
| Rizamat | 11.1                 | 186                       | 177.8                       | 95.5 |
| Smuglianka moldovskaya | 8.2             | 137                       | 127.8                       | 92.9 |
| Taify Pink | 7.6                  | 126                       | 120.1                       | 95.3 |
| TIR 05 | | 7.71                      |                             |     |

3. Conclusion

Variance analysis showed that the yield variation in Dekabrskii, Izabella, Kosmonavt, Kutuzovskii, Muskat Derbentskii, Pamiaty Ver derevskogo, Pamiaty Negru lia, Rizamat, Kishmish White, Kishmish Black, Muskat Gamburgskii is significant as it exceeds the level TIR05. The yield difference for the varieties Guliabi Dagestanskii, Kantemirovskii, Moldova, Nimrang, Smuglianka moldovskaya and Taify Pink is not significant. The accuracy is sufficient as the average error does not exceed 6 %. The parameters of the grapes commercial quality from the field should meet the requirements of GOST 25896 – 83 “Fresh Table Grapes. Technical conditions”.

The highest commercial grapes output from the field is for Rizamat – 95.6 %, Taify Pink – 95.3 %, Nimrant – 94.9 %, Agdai – 94.8 and Moldova – 94.3 %. The least commercial grapes output is for Guliabi Dagestanskii – 90.1 %, Izabella – 90.4 %, Kishmish Black – 90.5 % and Kishmish White – 90.8 %. The Kosmonavt and Kutuzovskii have the same commercial grapes output 83.2 %. The varieties Pamiaty Ver derevskogo and Pamiaty Negru lia are close to each other by this parameter 93.7 and 93.9 %. The varieties Dekabrskii Muskat Derbentskii Muskat Gamburgskii Kantemirovskii and Smuglianka moldovskaya have the commercial grapes output within 91.2–92.9 %, varying depending on the grapes variety.

Correlated-regression analysis (fig. 3) showed that the dependence between the crop yield and the commercial grape output is reliable and strong, and the form of correlation is direct (r=0.99). This dependence is described by the equation y=0.937x–1.2139. Regression coefficient bxy = 0.937 shows in which direction and how the function (y) changes when the argument (x) changes. Using the received equations we can construct the theoretical line of regression, according to which it is possible to predict the value of commercial grapes from yield. An increase in the yield of grapes for every 10 centners per hectare leads to an increase in the yield of commercial grapes by 9.37 %.

Table 3 and picture 4 show the data on identifying non-standard grapes in the –varieties under study.

The grapes harvested for stewing grapes and marinades should correspond to GOST 28472-90 "Fresh grapes of manual harvesting for preserving. Requirements for storage and delivery" (table 3).

Correlation-regression analysis helped determine an interesting regularity between the total sugars and the amount of berries, corrupted by illnesses and depredators. The relation between these
parameters is strong and is reliable and the form of correlation is direct \((r=0.69)\). This dependence is described by the equation \(y=0.2236x-2.1229\). It proves that when sugar increases per every gram/dm\(^3\), the number of berries corrupted by illnesses and depredators increases by 0.22 %.

![Correlated-regression dependence of the commercial grapes output on crop yield](image)

**Figure 3.** Correlated-regression dependence of the commercial grapes output on crop yield

| Table 2. Identifying non-standard grape |
|----------------------------------------|
| No. | Variety                          | Fracted bunches | Fallen berries | Cracked berries | Pea-size berries | Non-standard, total |
|-----|----------------------------------|-----------------|----------------|-----------------|-----------------|---------------------|
|     |                                  | c               | c               | c               | c               | c                   |
| 1   | Agadai                           | 4.62            | 0.52            | 0.13            | 1.63            | 6.9                 |
| 2   | Moldova                          | 4.96            | 0.69            | 0.41            | 1.84            | 7.9                 |
| 3   | Guliabi Dagestanskii              | 6.58            | 1.64            | 1.46            | 2.97            | 12.6                |
| 4   | Kosmonavt                         | 5.46            | 0.98            | 0.84            | 2.22            | 9.5                 |
| 5   | Pamiyat                          | 4.26            | 1.73            | 1.10            | 2.91            | 10.0                |
| 6   | Kantemirovskii                   | 4.79            | 2.19            | 1.68            | 2.61            | 10.2                |
| 7   | Kishmish White                   | 4.99            | 2.56            | 1.80            | 2.99            | 13.1                |
| 8   | Kishmish Black                   | 5.5             | 2.9             | 1.96            | 3.51            | 14.5                |
| 9   | Rizamat                          | 3.72            | 0.74            | 1.48            | 2.26            | 8.2                 |
| 10  | Taify Pink                       | 2.77            | 0.88            | 0.70            | 1.75            | 5.9                 |
| 11  | Muskat Derbentskii               | 5.77            | 2.49            | 2.20            | 1.82            | 10.9                |
| 12  | Muskat Gamburskii                | 4.48            | 2.06            | 1.03            | 2.63            | 10.2                |
| 13  | Dekabrskii                       | 5.58            | 3.87            | 2.55            | 1.82            | 13.6                |
| 14  | Nimrang                          | 2.94            | 0.76            | 0.12            | 2.68            | 6.5                 |
| 15  | Kutuzovskii                      | 5.36            | 1.29            | 1.14            | 2.11            | 9.9                 |
| 16  | Smuglianka moldovskaia           | 2.46            | 3.83            | 1.09            | 1.82            | 9.2                 |
| 17  | Pamiaty Negrulia                 | 3.4             | 2.55            | 1.50            | 2.41            | 10.4                |
| 18  | Izabella                         | 9.35            | 2.64            | 1.30            | 3.66            | 17.4                |
Table 3. Grape commercial quality according to GOST 28472-90 "Fresh grapes of manual harvesting for preserving. Requirements for storage and delivery"

| No. | Variety               | Total sugars, g/dm³ | Mashed berries, % | Wilted berries, % | Fallen berries, % | Berries corrupted by illness and depredators, % |
|-----|-----------------------|---------------------|-------------------|-------------------|-------------------|-----------------------------------------------|
| 1   | Agadai                | 14.09               | 0.7               | 1.6               | 0.4               | 1.5                                           |
| 2   | Gulabi Dagestanskii   | 16.45               | 1.9               | 2.9               | 1.3               | 2.3                                           |
| 3   | Dekabrskii            | 17.04               | 2.4               | 2.9               | 2.5               | 1.9                                           |
| 4   | Izabella              | 14.75               | 2.2               | 2.7               | 1.8               | 0.2                                           |
| 5   | Kantemirovskii        | 17.12               | 1.2               | 2.7               | 1.6               | 1.6                                           |
| 6   | Kishmish White        | 18.20               | 2.4               | 2.5               | 1.9               | 1.8                                           |
| 7   | Kishmish Black        | 19.01               | 2.3               | 2.4               | 1.7               | 1.7                                           |
| 8   | Kosmonavt             | 14.96               | 1.1               | 1.8               | 0.7               | 1.1                                           |
| 9   | Kutuzovskii           | 14.6                | 0.5               | 1.8               | 0.2               | 0.7                                           |
| 10  | Moldova               | 13.73               | 1.2               | 2.2               | 0.5               | 1.2                                           |
| 11  | Muskat Derbentskii;   | 18.04               | 1.8               | 2.7               | 2.2               | 2.1                                           |
| 12  | Muskat Gamburskii     | 18.05               | 1.9               | 1.9               | 2.0               | 2.0                                           |
| 13  | Nimrang               | 14.94               | 1.5               | 1.5               | 0.6               | 1.3                                           |
| 14  | Pamiat Verderevskogo  | 13.55               | 1.3               | 2.5               | 1.1               | 0.8                                           |
| 15  | Pamiat Negrula        | 14.7                | 1.8               | 2.8               | 1.5               | 1.2                                           |
| 16  | Rizamat               | 15.34               | 1.1               | 1.9               | 0.6               | 1.8                                           |
| 17  | Smuglianka moldovskaya| 14.8                | 2.1               | 2.3               | 2.8               | 0.9                                           |
| 18  | Taify Pink            | 15.51               | 0.8               | 1.6               | 0.7               | 1.4                                           |

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