

UDC 634.8: 551.58

УДК 634.8: 551.58

DOI 10.30679/2219-5335-2023-3-81-216-227

DOI 10.30679/2219-5335-2023-3-81-216-227

**AGROBIOLOGICAL REACTION
OF CENTENNIAL SEEDLESS
VARIETY TO LOAD OF BUSHES
BY SHOOTS AND BUNCHES**

**АГРОБИОЛОГИЧЕСКАЯ РЕАКЦИЯ
СОРТА КИШМИШ СТОЛЕТИЕ
НА НАГРУЗКУ КУСТОВ ПОБЕГАМИ
И ГРОЗДЯМИ**

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The article considers the issue of the impact of the load of table grape bushes with shoots and bunches on plant productivity. The place of research is the fourth subzone of the Central Agroecological Zone of viticulture

В статье рассмотрен вопрос влияния нагрузки кустов столового винограда побегами и гроздьями на продуктивность растений. Место исследований – четвертая подзона Центральной

of the Krasnodar region, characterized by a moderate continental climate and low-humus, leached powerful chernozems as soils. As an object of research after exploratory studies in 2021, among different table grape varieties (Gurman Kraynova, Dubovskiy rozovyi, Kishmish Dubovskiy and Centennial Seedless), the Centennial Seedless variety was selected as promising for studying the load of bushes with shoots and bunches according to the parameters of the proportion of fruiting shoots (93 %), the bunch weight (0.73 kg) and the productivity of the shoot (0.73 kg per shoot). According to the indicator complex in the first year of research after the experimental field trial, the following variants of bush loading with shoots and bunches were distinguished: the control first variant (35 shoots and 27 bunches per bush after breaking-off shoots) by the proportion of dead buds (16.7 %) and fruiting shoots (72.5 %), the number of inflorescences (30 pcs.), the fruitfulness coefficient k_1 (0.75), yield capacity (26.7 t/ha) and shoot productivity (0.59 kg per shoot); the fourth variant (23 shoots and 21 bunches) according to the fruitfulness coefficient k_1 (0.81) and the productivity of the shoot (0.7 kg per shoot), the fifth variant (23 shoots and 15 bunches) according to the fruitfulness coefficient k_2 (1.45), the bunch weight (0.91 kg), the loss from the bush (0.33 kg) and the productivity of the shoot (0.56 kg per shoot), the seventh variant (17 shoots and 15 bunches) according to the proportion of dead buds (16 %), fruitfulness coefficients k_1 (0.81) and k_2 (1.55); the ninth variant (13 shoots and 8 bunches) according to the proportion of fruiting shoots (61.5 %), fruitfulness coefficient k_1 (0.77) and shoot productivity (0.55 kg per shoot).

Key words: NORMALIZATION OF BUSHES, FRUITFULNESS COEFFICIENT, YIELD CAPACITY, BUNCH WEIGHT, SHOOT PRODUCTIVITY

агроэкологической зоны виноградарства Краснодарского края, характеризующаяся умеренно-континентальным климатом и малогумусными, выщелоченными мощными черноземами в качестве почв. В качестве объекта исследований после поисковых исследований в 2021 г. среди различных столовых сортов винограда (Гурман Крайнова, Дубовский розовый, Кишмиш Дубовский и Кишмиш Столетие) перспективным для изучения нагрузки кустов побегами и гроздьями выбран сорт Кишмиш Столетие по параметрам доля плодоносных побегов (93 %), масса грозди (0,73 кг) и продуктивность побега (0,73 кг/поб.). По совокупности показателей в первый год исследований после постановки экспериментального полевого опыта выделились следующие варианты нагрузки кустов побегами и гроздьями: контрольный первый вариант (35 побегов и 27 гроздей на куст после обломки) по доле погибших глазков (16,7 %) и плодоносных побегов (72,5 %), количеству соцветий (30 шт.), коэффициенту плодоношения (0,75), урожайности (26,7 т/га) и продуктивности побега (0,59 кг/поб.); четвертый вариант (23 побега и 21 гроздь) по коэффициенту плодоношения k_1 (0,81) и продуктивности побега (0,7 кг/поб.), пятый вариант (23 побега и 15 гроздей) по коэффициенту плодоносности k_2 (1,45), массе грозди (0,91 кг), потери с куста (0,33 кг) и продуктивности побега (0,56 кг/поб.), седьмой вариант (17 побегов и 15 гроздей) по доле погибших глазков (16 %), коэффициентам плодоношения k_1 (0,81) и плодоносности k_2 (1,55); девятый вариант (13 побегов и 8 гроздей) по доле плодоносных побегов (61,5 %), коэффициенту плодоношения k_1 (0,77) и продуктивности побега (0,55 кг/поб.).

Ключевые слова: НОРМИРОВАНИЕ КУСТОВ, КОЭФФИЦИЕНТ ПЛОДОНОШЕНИЯ, УРОЖАЙНОСТЬ, МАССА ГРОЗДИ, ПРОДУКТИВНОСТЬ ПОБЕГА

Introduction. Crop regulation is a necessary agrotechnological method to increase productivity and improve the quality of grapes [1-5]. Pruning shoots is one of the ways to normalize yield of grape bushes. It should be noted that in addition to the length of the shoot pruning [6], the pruning period also has an impact on grape yield [7].

The biological features of the variety and the formation of bushes determine the length of the pruning [6]. Seedless grape varieties react differently to the length of pruning: 8-10 buds are optimal for the Crimson Seedless variety [8], Sharad Seedless – 8 buds, Beauty Seedless and Thompson Seedless prefer a shorter one [3]. In Iran, White and colored varieties of seedless grapes *Vitis vinifera* L. turn out to be of higher quality when shoots pruning on 4 buds on a trellis [9]. The optimal load is 160 buds per bush, or 9 buds for a separate shoot, for the Kishmish Batyr variety in Tashkent with a planting scheme of 3 x 2.5 m [10].

The second way to normalize the yield is to regulate the load of bushes with shoots and bunches at the beginning of the growing season by breaking-off vegetative shoots. Despite the fact that the load of bushes with shoots is embedded in the pruning of last year's shoots [11], thinning of infertile shoots during flowering [12] or breaking-off of excess ones for the desired load [13] is performed. In the experiment on the Thompson Seedless variety with load of 30, 35 and 40 shoots per bush, the highest yield capacity, the ratio of sugar and acid was noted at a load of 35 shoots per bush. A linear increase in the bunch number of the Festival Seedless variety and the yield capacity of Flame Seedless and Crimson Seedless was noted with an increase in the bush load with shoots [3].

An increase in the bunch number of the Sharad Seedless variety leads to a decrease in the weight of berries [3]. The bunch load density of bushes was determined for the BRS Vitoria variety – 6 pcs. per m² with a single harvest per year (25 t/ha) [14] In addition, an experiment on thinning bunches was carried out on this variety and the optimal thinning period was determined to improve the quality of the yield (the diameter of the berries is 7-18 mm) [15]. For the BRS Isis variety

with a double harvest in year the bunch load density is 5 pcs. per m² according to research [16]. The highest quality yield of local clone variety Jumbo Seedless (India) is the yield obtained with a load of 23 bunches per bush (planting scheme 3 x 1.66 m), however, optimal parameters of productivity and quality of berries are achieved with a load of 27 pcs./bush [17]. In Russia, studies are also being conducted on the effect of loading bushes of seedless grape varieties with bunches. A difference in the commodity qualities of the yield under different bunch load was revealed for the Bessemyannyi Magaracha variety in the Krasnodar region, which, however, did not affect the selling price [18].

The purpose of this work was to evaluate the agrobiological reaction of the Centennial Seedless variety to various bush loads with shoots and bunches in the conditions of the Central Agroecological zone of viticulture of the Krasnodar region.

Objects and methods of research. The research was carried out on grape plantations of Krasnodar region, Peasant farm “T.B. Fisyura”. The vineyard is located in subzone 4 of the Central agroecological zone of viticulture, moderate continental climate. The average annual air temperature for the year is +12.7 °C (the climatological norm of the period 1991-2020). The absolute minimum and maximum air temperatures of the climatological period 1991-2020 were -27.7 °C and +40.7 °C, respectively. The sum of active air temperatures was equal to 3945 °C. The average total precipitation over 30 years was 728.8 mm. The soils are low-humus, leached powerful chernozems [19].

In 2021, a search study was carried out – a comparison of table grape varieties to determine the prospects of setting the experiment of loading bushes with shoots and bunches on table grape varieties. The objects were seed and seedless varieties on the SO4 rootstock with a 4x2 m planting scheme: Gurmant Kraynova (control), Dubovskiy rozovyi, Centennial Seedless, Kishmish Dubovskiy. The shape of the bushes is a high-standard two-armed cordon. Drip irrigation.

In 2022, the Centennial Seedless variety, a seedless grape variety of American origin, was selected for experimental field trial. The experimental field trial is based on a complete two-factor 3×3 scheme. Factor 1 – the load of bushes with shoots in three gradations: maximum, average and minimum; factor 2 – the load of bushes with clusters in three gradations: maximum, average and minimum (Table 1).

Table 1 – The load of bushes with shoots and bunches of the Centennial Seedless variety

| Variant | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--------------------|----|----|----|----|----|----|----|----|----|
| Shoots, pcs./bush | 35 | 33 | 33 | 23 | 23 | 23 | 17 | 17 | 13 |
| Bunches, pcs./bush | 27 | 20 | 13 | 21 | 15 | 10 | 15 | 10 | 8 |

Agrobiological records were carried out according to the method of M.A. Lazarevsky [20] and included the determination of the number of developed shoots and clusters, dead buds at the end of the phenological phase budbreak-flowering, crop accounting at the onset of physiological maturity of grape berries. Statistical data processing was carried out according to the method of B.A. Dospekhov [21].

Discussion of results. The dormant period of 2020/2021 was cooler than the average for 30 years – the average air temperature was +1.4 °C, 0.3 °C below the climatological norm of 1991-2020, the temperature dropped to -18 °C. April was also cool – +11.1 °C, 1.3 °C below normal. The vineyards were opened in mid-April. The average air temperature for April-September was +20 °C, which is 0.2 °C below normal. The absolute maximum air temperature was +38 °C. The total precipitation of the period from April to September was higher than the average meaning – 443 mm, almost 100 mm more than normal (Fig.).

The dormant period of 2021/2022 was characterized by an elevated temperature regime – the average air temperature of December-January was +4 °C. The absolute minimum was recorded in the third decade of December (-13 °C),

which is unusual for this territory. The fall of precipitation over the winter was more than climatological norm by 50 mm (244 mm). April was warmer than in 2021 and the average temperature was 1 °C above normal and amounted to +13.4 °C. The opening of the vineyards began in the second decade of April. Budbreak was noted on April 18. The average air temperature of April-September was only one tenth of a degree higher than 2021 and amounted to +20.1 °C. The absolute maximum temperature has not changed since last year. The amount of precipitation was close to 2021 – 426.9 mm (Fig).

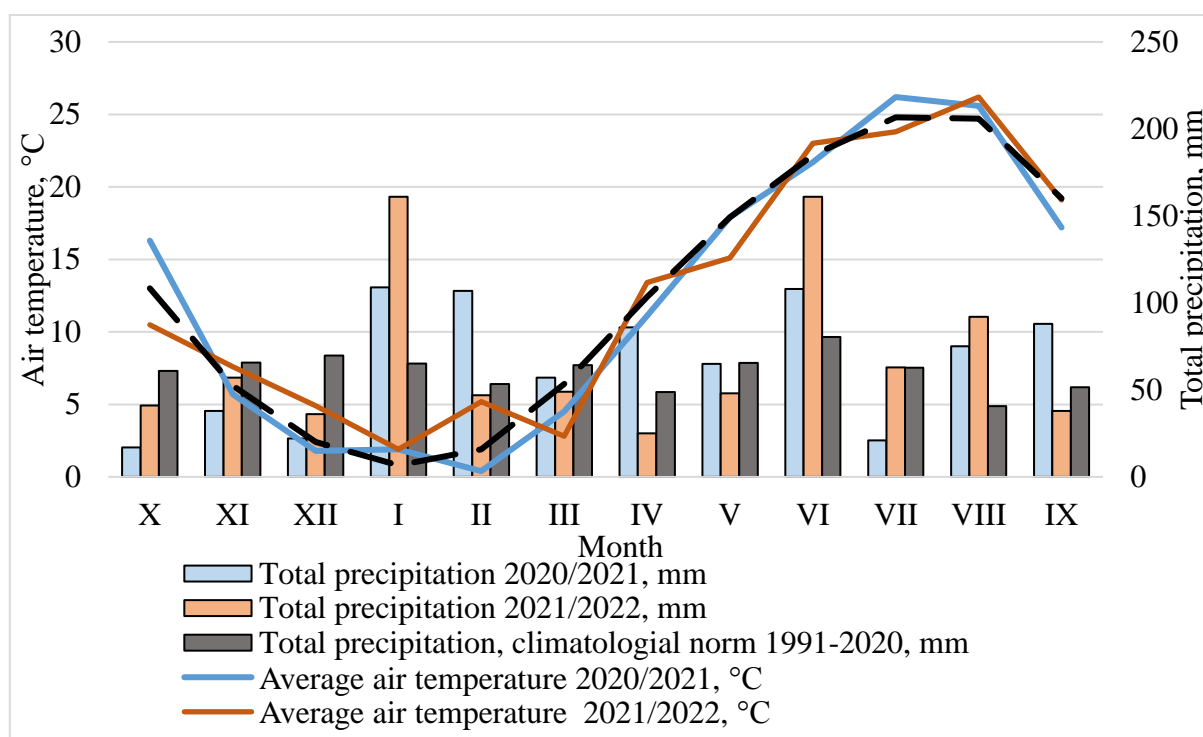


Fig. Meteorological conditions of 2020/2021 and 2021/2022

In 2021, a search study was carried out on the varieties Gurman Kraynova, Dubovskiy rozovyi, Centennial Seedless, Kishmish Dubovskiy to determine the prospects for studying the influence of agrotechnological methods on the varieties (Table 2). According to the proportion of undeveloped buds compared to the control zoned variety, Kishmish Dubovskiy was distinguished, to the fruiting shoots – Centennial Seedless. Fruitfulness coefficient k_1 in all varieties was lower than

the control, but higher or equal to 1.0, which indicates a high fruitfulness of shoots. By the bunch weight, the Centennial Seedless variety stood out. The yield from the bush and the yield capacity were lower in all varieties compared to the control, but the productivity per shoot of Centennial Seedless variety was higher than of the control variety.

Table 2 – Productivity of promising table grape varieties in agroecological conditions of the Central viticulture zone, Krasnodar region, 2021

| Variety | Number of shoots, pcs./bush | Number of fruiting shoots, pcs./bush | Number of clusters, pcs./bush | Dead buds, % | Fruiting shoots, % | Fruitfulness coefficient k1 | Fruitfulness coefficient k2 | Bunch weight, кг | Yield, kg/bush | Yield capacity, t/ha | Productivity of shoot, g/shoot |
|---------------------------|-----------------------------|--------------------------------------|-------------------------------|--------------|--------------------|-----------------------------|-----------------------------|------------------|----------------|----------------------|--------------------------------|
| Gurman Kraynova (control) | 32 | 22 | 34 | 23 | 68.8 | 1.06 | 1.55 | 560 | 17.3 | 21.6 | 593.6 |
| Dubovskiy rozovyi | 16 | 13 | 17 | 17 | 81.3 | 1.06 | 1.31 | 480 | 7.2 | 9 | 508.8 |
| Centennial Seedless | 14 | 11 | 14 | 22.2 | 78.6 | 1 | 1.27 | 730 | 10.2 | 12.8 | 730.0 |
| Kishmish Dubovskiy | 22 | 16 | 22 | 12 | 72.7 | 1 | 1.38 | 470 | 8.9 | 11.1 | 470.0 |
| LSD ₀₅ | 4.52 | 3.48 | 4.72 | 3.34 | 4.89 | 0.41 | 0.55 | 17.44 | 3.35 | 3.74 | 17.06 |

According to the totality of traits, the Centennial Seedless variety was selected for a two-factor trial on the loading of bushes with shoots and bunches.

Table 3 shows data from 2022 before breaking-off shoots. The largest share of dead buds among the variants of load with shoots and bunches was noted in the third – 42.9 %. In the control first variant the share was 16.7 %. The lowest death bud share was in the seventh variant – 16 %.

According to the proportion of fruiting shoots, the first variant stood out – 72.5 %. The lowest share of fruiting shoots was observed in the sixth variant – 38.5 %. The number of clusters was also the largest in the first variant – 30, the smallest – in the ninth variant (10).

High fruitfulness of shoots according to the fruitfulness coefficient k_1 was observed in the fourth and seventh variants (0.81). The average fruitfulness was observed in the remaining variants, the first (0.75), second (0.72) and ninth (0.77) variants should be noted separately.

The highest fruitfulness coefficient k_2 was observed in the fifth (1.45), sixth (1.5) and seventh (1.55) variants. The lowest fruitfulness coefficient k_2 was in the first variant (1.03).

Table 3 – Agrobiological indicators of the Centennial Seedless variety in agroecological conditions of the Central viticulture zone, Krasnodar region, 2022¹

| Variant | Number of buds, pcs./bush | | Dead buds, % | Number of shoots, pcs./bush | | Fruiting shoots, % | Number of clusters, pcs./bush | Fruitfulness coefficient k_1 | Fruitfulness coefficient k_2 |
|-------------------|---------------------------|---------------------|--------------|-----------------------------|--------------------|--------------------|-------------------------------|--------------------------------|--------------------------------|
| | total | including developed | | total | including fruiting | | | | |
| 1 (c) | 48 | 40 | 16.7 | 40 | 29 | 72.5 | 30 | 0.75 | 1.03 |
| 2 | 46 | 36 | 21.7 | 36 | 20 | 55.6 | 26 | 0.72 | 1.3 |
| 3 | 63 | 36 | 42.9 | 36 | 19 | 52.8 | 21 | 0.58 | 1.11 |
| 4 | 40 | 27 | 32.5 | 27 | 16 | 59.3 | 22 | 0.81 | 1.38 |
| 5 | 37 | 26 | 29.7 | 26 | 11 | 42.3 | 16 | 0.62 | 1.45 |
| 6 | 32 | 26 | 18.8 | 26 | 10 | 38.5 | 15 | 0.58 | 1.5 |
| 7 | 25 | 21 | 16 | 21 | 11 | 52.4 | 17 | 0.81 | 1.55 |
| 8 | 23 | 19 | 17.4 | 19 | 10 | 52.6 | 13 | 0.68 | 1.3 |
| 9 | 16 | 13 | 18.8 | 13 | 8 | 61.5 | 10 | 0.77 | 1.25 |
| LSD ₀₅ | 2.9 | 2.3 | 2.3 | 2.3 | 2.0 | 2.4 | 2.4 | 0.30 | 0.29 |

The average bunch weight increases with a decrease in the load of bushes with shoots and bunches, and then decreases. The largest bunch weight was in the fifth variant with a load of 23 shoots and 15 bunches per bush – 910 g, in the control variant (35 shoots and 27 bunches) – 790 g (Table 4).

¹ before breaking-off shoots

Table 4 – Productivity of the Centennial Seedless variety in the conditions of the Central agroecological zone of viticulture in 2022

| Variant | Number of shoots, pcs./bush | Number of bunches, pcs./bush | Average bunch weight, g | Yield, kg/bush | Yield loss, g/bush | Yield capacity, t/ha | Productivity of shoot, g/shoot |
|-------------------------|-----------------------------|------------------------------|-------------------------|----------------|--------------------|----------------------|--------------------------------|
| 1 (c) | 35 | 27 | 790 | 21,33 | 600 | 26,66 | 592,5 |
| 2 | 33 | 20 | 750 | 15 | 600 | 18,75 | 540 |
| 3 | 33 | 13 | 810 | 10,53 | 610 | 13,16 | 469,8 |
| 4 | 23 | 21 | 860 | 18,06 | 580 | 22,58 | 696,6 |
| 5 | 23 | 15 | 910 | 13,65 | 340 | 17,06 | 564,2 |
| 6 | 23 | 10 | 880 | 8,8 | 330 | 11 | 510,4 |
| 7 | 17 | 15 | 650 | 9,75 | 440 | 12,19 | 526,5 |
| 8 | 17 | 10 | 680 | 6,8 | 460 | 8,5 | 462,4 |
| 9 | 13 | 8 | 720 | 5,76 | 350 | 7,2 | 554,4 |
| <i>HCP₀₅</i> | 2,2 | 1,9 | 7,33 | 1,76 | 8,46 | 1,97 | 6,46 |

The yield was the highest at maximum load (control variant) and was 21.3 kg per bush (26.7 t/ha). The yield is more than 10 kg per bush for variants from the first to the fifth (from 10.5 to 21.3 kg/bush), the yield capacity is more than 10 t/ha for variants from the first to the seventh (from 11 to 26.7 t/ha). Yield losses of more than 5 % were noted in the third (5,5 %), eighth (6,3 %) and ninth (5.7%) variants. According to the indicator "shoot productivity", the fourth (23 shoots and 21 bunches per bush) stood out against the background of the control variant – 697.6 g/shoot; productivity above 550 g per shoot was observed in the fifth and ninth variants.

Conclusions. In the course of search study, the Centennial Seedless variety was chosen as a promising one for studying the load of bushes with shoots and bunches among table varieties. The agrobiological indicators of the Centennial Seedless variety have been changing under the influence of different load of bushes with shoots and bunches. The highest yield capacity was noted (26.7 t /ha) when the bushes were loaded with 35 shoots and 27 bunches after breaking-off shoots. The highest productivity of the shoot (696.6 g/shoot) was noted with the

bush load of 23 shoots and 21 bunches. The highest bunch weight (910 g) was when the bushes were loaded with 23 shoots and 15 bunches.

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