



Full Length Research Article

Advancements in Life Sciences – International Quarterly Journal of Biological Sciences

ARTICLE INFO

Open Access



Date Received:
27/06/2022;
Date Revised:
19/08/2022;
Date Published Online:
31/10/2022;

Introduction of Large-Fruited Strawberry Varieties on the Territory of the Novosibirsk Region in the Conditions of Western Siberia

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Abstract

Background: For the Novosibirsk region, the need for planting material suitable for growing varieties is very high. The relatively easy technology of growing strawberries allows obtaining high yields not only for those who grow them but also on an industrial scale. Strawberry fruits contain a huge number of useful elements, including vitamins, which are necessary for the human body. The study aimed to determine the influence of the maturity group on the yield of introduced varieties of large-fruited garden strawberries.

Methods: Records and observations were carried out from May 2019 to September 2020 at the collection site of the biological polygon of the Federal State Budgetary Research Institution Siberian Physical and Technical Institute in the Novosibirsk Region.

Results: During the years of the study, the weather conditions of the spring period developed successfully for the growth and development of strawberries. Thus, on average, over the years of the study, high yields were shown of different maturity groups.

Conclusion: The obtained yield indicators obtained were not inferior to previously zoned and local varieties, which shows that planting can be carried out both in traditional soil and in soilless culture. Thus, the quality and quantity of fruits does not change with the physicochemical properties or methods of cultivation but depends on the age of the plant and the seasonal crop cycle.

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How to Cite:
Makarova K, Petrov A, Pastukhova A, Gazizulina A, Petruk V, Gotfrid S, (2022). Introduction of Large-Fruited Strawberry Varieties on the Territory of the Novosibirsk Region in the Conditions of Western Siberia. Adv. Life Sci. 9(3): 328-328.

Keywords:
Strawberry; Variety; Yield; Growing season; Technology; Introduction



Introduction

Strawberries are the most popular berry crop in the whole world [1]. Garden strawberries are popular due to the content of ascorbic acid. Due to the high content of biologically active substances, berries have the necessary therapeutic, as well as high dietary properties [2]. According to studies on the nutritional value of large-fruited garden strawberries by M.Yu. Akimov, E.V. Zhbanova, V.N. Makarov, and others, a comprehensive assessment of strawberry fruits shows that their chemical composition may vary due to varietal characteristics [3]. A certain amount of sugar, organic acids, vitamins C, B9, P-active compounds, and pectin substances will accumulate in berries of various varieties. These substances help strengthen the human immune system, improve metabolism and strengthen the heart muscle. The high content of iron salts in berries helps to increase iron content in human blood and improve blood circulation [4]. In addition to food and dietary value, the berries also have several positive distinguishing features: they are early-producing, early-ripening, give high yields, multiply quickly, have inertia to grow in rather harsh conditions, do not suffer from the periodicity of fruit-bearing, and quickly pay off [5, 6].

The study aimed to compare yields for 1 growing season in remontant, early-ripening, medium-ripening, and late-ripening varieties of large-fruited garden strawberries for the introduction of different varieties in the territory of the Novosibirsk region.

Methods

Records and observations were carried out from May 2019 to September 2020 at the collection site of the biological polygon of the Federal State Budgetary Research Institution Siberian Physical and Technical Institute (FGBNU SibFTI) located in Novosibirsk Region, Russia according to the program and methods of variety study for fruit, berry and nut crops. The climate of the Novosibirsk region is characterized by pronounced continentality with long winters and short, but hot, often dry summers. Currently, the soil of the Novosibirsk region is characterized by the manifestation of such negative processes as a decrease in the reserves of humus content, waterlogging (including secondary), land salinization. In recent years, the violation of tillage technology has become common, leading everywhere to increased erosion and gully formation. Wind and water erosion are the main factors that reduce soil fertility. So, the basic principle of this method is the ecological and geographical testing of new breeding and introduced varieties in soil conditions of the Novosibirsk region. The method proven itself well in Russia, the natural conditions of which are exceptionally diverse. Ecological and geographical testing allowed us to identify flexible

varieties that have high adaptive ability or most fully reveal their capabilities in new conditions [7]. During the experiment the following indicators were taken into account: the general condition of plants in spring and autumn, winter hardiness, phenological phases of development, resistance to diseases and pests, and the accounted yield.

Maturity groups	Variety
Early-ripening (16.06 – 20.06)	Zefir, Holiday, Estafeta, Festivalnaya, Festivalnaya romashka, Alba, Suzy, Anastasia, Honey, Tsaritsa (D), Mara de Bois, Daroyal, Ballerina, Daryonka
Medium-ripening (21.06 – 30.06)	Tenira, Rubinovyi kulon, Bereginya, Borovitskaya, Ruslan, Slavutich, Solovushka, Nancy, Maryshka, Orlets, Kokinskaya zarya, Pervoklassnitsa, Duet, Eliani, Aleksandrina, Anna, Kupchikha, UniaSmides, Zenga-Zengana, Elsanta, Dukat, Ksima, Feierverk, VimaTarda, Aziya, Neznakomka, VimaKsima, Corrado, Troitskaya, Alenushka, Venera, VimaZanta, Solnechnaya polyanka, Simfoniya, Vima Kimberly, Korona, Tryufel, Tanyusha, Feya, Tsaritsa (K), Vityaz, Studencheskaya, Sara, Honeoye, Polka, Rusich, Darselect
Late-ripening (01.07 – 10.07)	Vicoda, Malvina, Alpha, Florence, Mice Schindler, Chernyi prints, Florace, Isaura, Pineberry, Tarda, Ananasa, Roxana.
Remontant (27.05 – 18.09)	Remontnaya krupnoplodnaya, Ostara, Vima, Rina, Selva, Pink Panda, Albion, Monterey

Table 1: List of studied varieties of large-fruited garden strawberries

A one-factor field experiment (collectible plantings) was set up. The plants were planted in a belt layout with a 20 x 20 cm feeding area per 1 plant. The setup of the experiment and the experimental work was carried out according to the methods developed by V.A. Dospekhov [8]. The methods of field experiment included the following constituent elements: the number of variants, the area and the system of placement of plots, the method of accounting for the yield, and the organization of the experiment in time. It is known that mistakes made at any stage of experimental work violate the comparability of variants and the accuracy of the study, so at the beginning, we drew up a schematic plan where the exact size of the entire experiment, the number of repetitions, plots, tracks, headlands, etc. were indicated [9]. The objects of the study were varieties of large-fruited garden strawberries of various maturity groups: early-ripening (14 varieties), medium-ripening (47 varieties), late-ripening (12 varieties), and remontant (7 varieties) (Table 1). The data obtained were converted into Excel tables and processed using the statistical programming language "R".

Results

For the threshold of vegetation of strawberry plants, the date of establishment of average daily temperatures above 5°C was considered. The weather conditions of the spring period, at the time of the study, were developing successfully for the growth and development of strawberries. At the time of flowering of strawberry plants (end of May to June), there were no recurrent frosts. The flowering phase occurred at the end of

May/beginning of June, but taking into account the weather and climatic conditions, preference in the Novosibirsk region should be given to varieties with early and simultaneous ripening of berries.

Figure 1 shows that the period from the beginning of the growing season to the beginning of maturation in all early varieties of large-fruited garden strawberries was formed in the same period equaling 54 to 60 days (60 days for the Tsaritsa variety). No special differences were observed, and during the duration of fruit-bearing, the Honey variety demonstrated a minimum number of days (14 days). The Festivalnaya and Anastasia varieties had a longer fruit-bearing period equaling 25 days. According to the number of harvests, the following varieties showed the maximum values: Festivalnaya and Anastasia (6 harvests), while the minimum number was observed in the Alba variety (3). The rest of the varieties had 4-5 harvests.

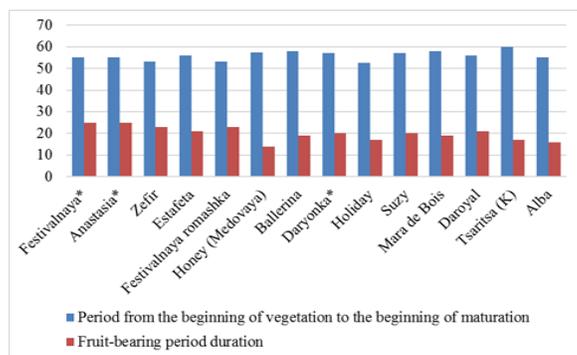


Figure 1: The number of days before the beginning of maturation and the duration of fruit-bearing of early-ripening varieties

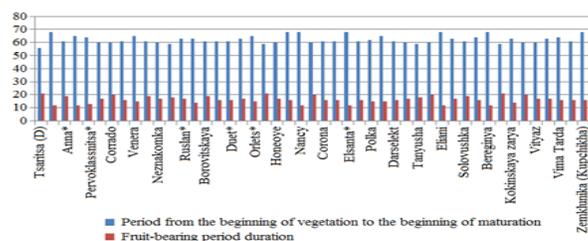


Figure 2: The number of days before the beginning of maturation and the duration of fruit-bearing of early-ripening varieties

Figure 2 shows 47 varieties of medium-ripening large-fruited garden strawberries. The period from the beginning of vegetation to the beginning of maturation had the greatest number of days in seven varieties: Anna, Honeoye, Nancy, Elsanta, Eliani, Bereginya, and Zemklunika (Kupchikha), equaling 68 days. For the Tsarina variety this period equaled 56 days, and for Alyonushka, Dukat, Tanyusha, and Studentskaya it was 59 days. For other varieties, this period ranged from 60 to 65 days. According to the duration of the fruit-bearing period, the medium-ripening varieties of large-fruited garden strawberries were divided as follows. The maximum number of 20 and 21 days was observed in the

varieties Tsaritsa, Corrado, Ducat, Xima, Tryufel, Studencheskaya, and Rusich. The minimum number was 12 days in such varieties as Alexandrina, Troitskaya, Nancy, Elsanta, Eliani, and Bereginya. For the remaining varieties, this period ranged from 15 to 19 days.

In this group, for such varieties as Tsaritsa, Anna, Corrado, UniaSmides, Borovitskaya, Rubinovyi kulon, Ducat, Xima, Tryufel, Solovushka, Studencheskaya, Rusich the number of harvests did not exceed five. The minimum number of harvests was observed in such varieties as Alexandrina, Troitskaya, Pervoklassnitsa, Maryshka, Honeoye, Nancy, Eliani, Bereginya, and Koksinskaya zarya, where this value did not exceed three. Figure 3 shows in late-ripening varieties that the period from the beginning of vegetation to the beginning of maturation is much longer than in early-ripening and mid-ripening varieties of large-fruited garden strawberries. The maximum number of days (78) was observed in the Malvina variety. The minimum number of days (69) was observed in the Alpha and Pineapple varieties. In other varieties, the number of days varied from 70 to 75 days.

Considering the fruit-bearing period, it can be noticed that it was much shorter than in early and medium-ripening varieties. The maximum number of days was 14 and was observed in the Malvina variety, while the minimum number (6 days) was observed in the Vicoda and Pineberry varieties. The remaining varieties on average had a fruit-bearing period from 7 to 10 days.

In varieties in this group, the number of harvests did not exceed three. In the group of remontant varieties of large-fruited garden strawberries consisting of seven varieties (Figure 4), it can be seen that the fruit-bearing period was much longer than in the above-listed groups, and the number of harvests varied from 9 to 13. The largest number (13) was observed in the Ostara variety, in the Selva, Remontantnaya krupnaya, and VimaRina varieties 12 harvests were obtained, in the Albion variety this number equaled 11, in Pink Panda 10, and the minimum number (9) was observed in the Monterey variety.

According to the period from the beginning of the growing season to the beginning of maturation, the varieties were distributed as follows: the maximum number of days (69) was observed in the Pink Panda variety, and the minimum (53 days) was noted in the Remontantnaya krupnaya variety.

The fruit-bearing period in Ostara and Remontantnaya Krupnaya varieties lasted for 85 and 83 days, respectively, in the Selva variety for 23 days, and in the remaining varieties, it ranged from 62 to 75 days. The yield of large-fruited garden strawberries can be considered as a linear meter, i.e., from 3 plants, and 1 plant. Figures 5-8 show yield graphs from 1 large-fruited strawberry plant.

Figure 5 shows fluctuations in yield in early-ripening varieties of large-fruited garden strawberries. Thus, in the group of early-ripening varieties of large-fruited garden strawberries, the following varieties had the maximum yield: Anastasia and Ballerina, with 104.03 g and 102.89 g, respectively, from 1 plant. The lowest yield was noted in such varieties as Honey (Medovaya) with 57.37 g and Tsaritsa with 54.86 g from 1 plant. On average, the yield of the remaining varieties from this group ranged from 70 to 80 g.

The maximum weight of berries in all varieties was more than 10 g. The maximum weight was noted in the Alba variety (36g), followed by the Festivalnaya variety (26 g), Zefir (22 g), and the minimum weight was noted in the Suzy variety (13.03 g). The remaining varieties' yield varied from 15 to 20 g.

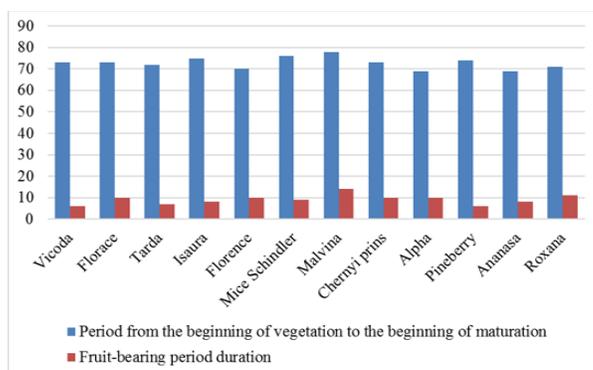


Figure 3: The number of days before the beginning of maturation and the duration of fruit-bearing of late-ripening varieties

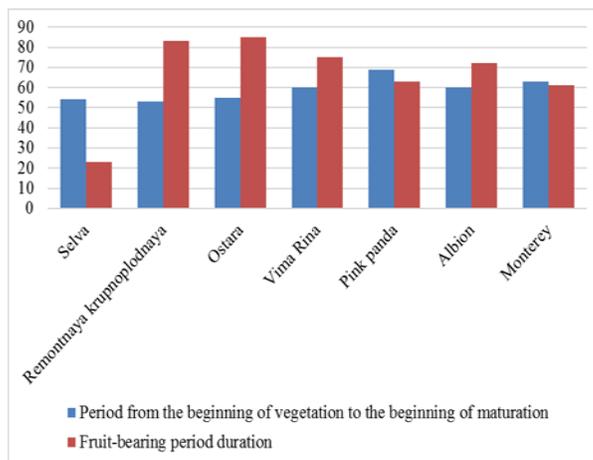


Figure 4: The number of days before the beginning of maturation and the duration of fruit-bearing of remontant varieties

In Figure 6, the following varieties of medium-ripening strawberries showed the maximum yield: Bereginya (147.67 g), Tenira (145.75 g), Vima Kimberly (136.54 g), Asia (131.14 g), Orlets (127.81 g), and UniaSmides (125.98 g). The lowest yield was observed in such varieties as Tanyusha and Honeoye, with 36.74 g and 38.19 g, respectively, from 1 plant. On average, the

yield of the remaining varieties ranged from 70 to 90 g. The maximum weight of the berry on average varied from 15 to 22 g from 1 plant, but the group is large, and the spread is large. At the same time, the maximum berry weight was 36 g in the Dukat variety, 34 g in the Asia variety, and 33 g in the Ruslan variety. The minimum weight was 5 g in the Zemklubnik (Kupchikha) variety.

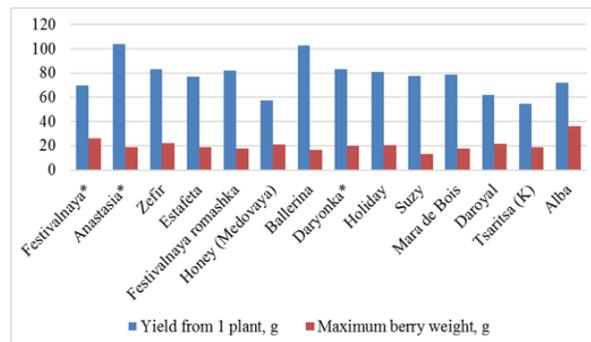


Figure 5: Yield and a maximum weight of berries of early-ripening varieties

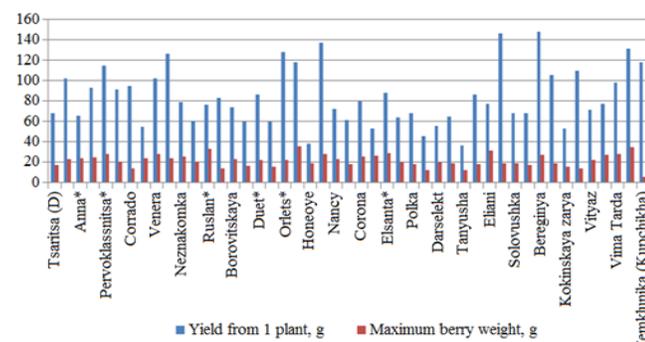


Figure 6: Yield and a maximum weight of berries of medium-ripening varieties

In late-ripening varieties (Figure 7) of large-fruited garden strawberries, the Florace variety had a high yield of 156.78 g per 1 plant. The minimum yield was noted in the Ananasa and Pineberry varieties equaling 18.52 g and 27.49 g, respectively. The remaining varieties had a yield of 70 to 100 g. According to the maximum weight of berries, it is clear that only 4 varieties exceeded 20 g. The maximum weight was observed in the Alpha variety (32 g), Malvina (24 g), Florence (22 g), and Tarda (23 g). The minimum weight was noted in such varieties as Ananasa (4 g) and Pineberry (6 g).

When considering the remontant varieties (Figure 8) of large-fruited garden strawberries, the highest yield was observed in the Remontantnaya krupnaya (425.42 g) and VimaRina varieties (411.27 g per 1 plant), and the lowest one in Monterey (80.7 g). At the same time, the maximum weight of berries in the varieties was observed with a slight difference. Thus, in the Selva variety, it equaled 28 g, in VimaRina 23 g, in Monterey 7 g, and

Pink Panda 9 g. The berries of the other varieties were in the weight range from 13 to 17 g.

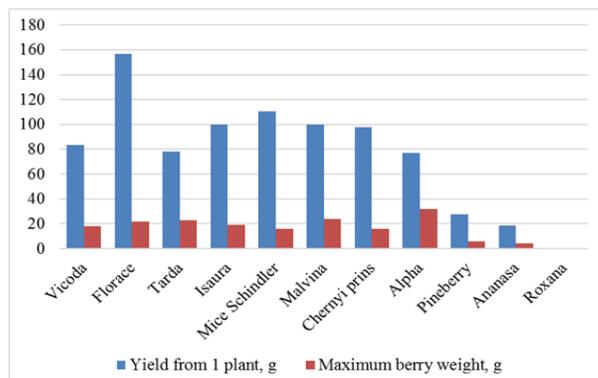


Figure 7: Yield and a maximum weight of berries of late-ripening varieties

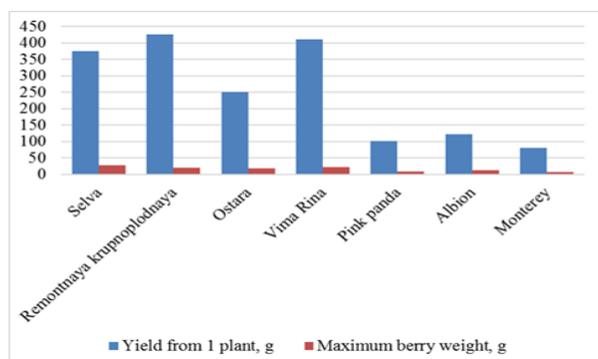


Figure 8: Yield and a maximum weight of berries of remontant varieties

Discussion

Based on the purpose of our study to determine the effect of the ripeness group on the yield of introduced varieties of large-fruited garden strawberry, we selected four varieties of large-fruited garden strawberry of different ripeness groups: early-ripening, mid-ripening, late-ripening and remontant. The main indicator of various maturity groups is the yield, which depends on weather conditions and the number of flower stalks formed, and then the commercial-grade berries formed on them [10].

Unlike Rahman et al. [11], our research is consistent with the results of [12, 13] which showed that the introduced strawberry varieties proved to be stable regardless of the maturity group in the ground. When studying the physicochemical properties and methods of cultivation, the quality of fruits changed with the age of the plant and the seasonal cycle of the harvest, and the preferences were similar, both in traditional soil and in groundless culture. In the territory of India, Taiwan, Turkey, and Italy, research is underway on methods of growing strawberries not only on the ground but also in groundless systems [14-16]. Such methods allow

harvesting strawberries regardless of weather conditions. Further research, in groundless conditions, can open up new ways for variety introduction. These studies have suggested that the study of our varieties can get a similar result. In this study, the nutritional value and importance of strawberry varieties for human health were determined using advanced analysis methods [17-19]. During our study, minimal damage to plants by diseases and pests was observed.

From this study, we concluded that parasitism is a major health problem for camels because parasites get food and shelter from the host and cause disease. This research shows the high prevalence rate of nematohelminthes of different species. In this research area, people use camels for meat and draught purpose. This study shows the high attack of gastrointestinal nematohelminthes on camels and their production is used as food by people. For this purpose, it is suggested that deworming should be done properly after regular intervals with safe and low cost effective anthelmintic drugs (Albendazole, levamisole and Ivermectin). Farmers should be educated through the trained team of the Camel Center to assess the aspects of camel health, management and breeding. Due to the high cost of anthelmintic drugs and checkup fees of veterinarians poor owners do not connect with them and destroy the health of animals which causes a huge earning loss.

Competing Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

All authors contributed equally to concept development and study design, data collection, data analysis and interpretation, draft of article preparation and critical revision of the article.

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