

# A Study of Growth Features of Remontant Raspberries in the Komi Republic

Tatiana V.Tarabukina<sup>1</sup>, Andrey A.Yudin<sup>1,\*</sup>, Elena V.Pavlova<sup>1</sup>, Elena V.Krasilnikova<sup>1</sup>

<sup>1</sup>Institute of Agrobiotechnology named after A.V. Zhuravsky, Federal Research Center for Nutrition, Biotechnology and Food Safety, Komi Scientific Center of the Ural Branch of the Russian Academy of Sciences, Syktyvkar

\*corresponding author E-mail:

**Abstract:***Background information/ Relevance:* Berry crops are one of the most effective sources of vitamins. Of the berry crops cultivated in the Komi Republic, red raspberries are of particular importance for the North (R. Idaeus L).

*The objective is to study the features of the growth of varieties of remontant raspberries in the conditions of the Komi Republic.*

*Methods:* The research was carried out in the fruit and berry nursery of the Institute of Agrobiotechnology 'Federal Research Center for Nutrition, Biotechnology and Food Safety' Komi Scientific Center of the Ural Branch of the Russian Academy of Sciences following the 'Program and methods of variety study of fruit, berry and nut crops' (1999) and 'Field Test Techniques' (1985).

*Findings:* In 2020, the remontant raspberry varieties were divided by the timing of the beginning of flowering into two groups, medium and late. They also have significant differences in the formation of the total number of shoots, replacement shoots, and root suckers.

*Conclusions:* As a result of the research carried out, varieties with a complex of economically useful features were identified: Ruby necklace and Firebird.

**Keywords:** Remontant raspberries, variety study, raspberry growth, phenological observations, habit (or habitus)

## I. INTRODUCTION

The berry crop can be considered the most reliable and effective source of growth of vitamin production, and this crop can also solve many problems of import substitution (Kulikov, 2015).

Inhabitants of northern countries are deficient in a large number of vitamins, thus, berry crops can replenish the reserves of the latter, in this regard, this direction is considered quite promising in the Komi Republic (Sokerina, 2017). Another reason for the cultivation of berry crops is climatic crops, since they are quite winter-hardy, they can quickly recover, multiply and take root, also, according to the literature, they begin to bear fruit early (Komistat, 2015).

Berry crops cultivated in the republic such as red raspberries (R. Idaeus L.) are of particular importance for the North, as they are used to treat diseases. Berry crops have a high level of antioxidants, antioxidant capacity, and anticarcinogenic properties (Sasnauskaset al., 2011).

To identify the most adaptive varieties of berry crops for a complex of basic economically useful traits, in 2005, based on the Scientific Research Institute of Agriculture of the Komi Republic, new collection areas of berry crops were laid, from 2008 to 2013 Sokerina N.N. studied the development of 20 varieties of raspberries of different ripening terms according to the phases of their development, depending on the climatic conditions of the growing season. The productivity potential of raspberries directly depends on the overwintering of plants (Glyadelkina, 2008; Sokerina, 2017).

In recent years, interest has been revealed in remontant and photoneutral forms of raspberries. The reparability of raspberries was noticed and began to be used about 200 years ago. In the beginning, the autumn harvest was small, with individual berries on individual shoots. The quality of the berries was significantly inferior to the summer varieties (Sagirova et al., 2016).

The main areas of breeding for varieties that bear fruit on two-year-old stems are the creation of winter-hardy, resistance to fungal and viral diseases, drought- and heat-resistant, high-yielding forms with high-quality fruits of different ripening periods. For remontant raspberries, it is relevant to obtain varieties with a short fruiting period, high palatability, the rich biochemical composition of fruits resistant to the raspberry bushy dwarf virus, botrythiasis, anthracnose, and root rot.

The cultivation of remontant varieties of raspberries as an annual crop eliminates the problem of winter hardiness of the stems, and their removal from the plantation after mowing allows you to get rid of the main diseases and pests without the use of pesticides. On the other hand, leaving annual shoots for the second year, gardeners get very extended periods of fruiting, which turns out to be attractive for amateur gardening, especially in the south of the European part of Russia.

Over the past 5 years, 15 varieties of raspberries have been included in the State Register of Breeding Achievements of the Russian Federation (2020), of which 11 are of the remontant type. The latest of the new varieties are the following: Atlant (2015), Lel (2015), Shahrazada (2015), Blesk (2016), Caramelka (2016), Cleopatra (2017), Gift to Kashin (2017), Bow to Kazakov (2017), Raspberry ridge (2019), Pokhvalinka (2019), Samokhval (2019). The identified varietal assortment will be offered for implementation in the Farm-economy, horticultural societies, and private farms of the Komi Republic.

The research objective is to study the growth features of remontant raspberries in the Komi Republic.

## II. MATERIALS AND METHODS

The object of research is a collection nursery of remontant raspberries.

Research methods are stationary experiences; methods of mathematical data analysis.

In 2018, the laying of a collection nursery of remontant forms of raspberries began: winter-hardy; with high productivity and large-fruited; able, unlike ordinary raspberry plants, to bear fruit on annual shoots. Collection variety study was carried out according to a reduced program on a smaller number of plants of each variety. The purpose of the collection study is an accelerated preliminary assessment of varieties for the selection of some of them for primary study. Individual selective seedlings from one's own or other breeding establishments, varieties and forms of folk breeding, introduced varieties, as well as those included in the State Register of Breeding Achievements of the Russian Federation, can be planted in the collection (Sedova and Ogoltsova, 1999).

The experience site is typical for the zone. The soil of the experimental plots is sod-podzolic, loamy, enriched with compost, and peat.

In the third year of study in the fruit and berry nursery of the Institute of Agrobiotechnology 'Federal Research Center for Nutrition, Biotechnology and Food Safety' Komi Scientific Center of the Ural Branch of the Russian Academy of Sciences, the collection nursery of remontant raspberries was represented by 5 varieties, i.e. 3 of them were introduced populations from the Kirov region and two selected seedlings of the Institute of Agriculture of the Komi Scientific Center of the Ural Branch of the Russian Academy of Sciences. All varieties are included in the State Register of Breeding Achievements of the Russian Federation.

The studies were carried out according to the main provisions of the methodology (Dospekhov, 1985). Raspberry varieties for study in the collection were planted in the form of small well-lit groups (clumps), 3-4 plants in each replication in rows according to the planting scheme 3x0.5 m. Repetition three times. The placement of varieties is randomized. The distance between the varieties is 2 m (Sagirova et al., 2016). This planting scheme is recommended by the author of remontant varieties, academician of the Russian Academy of Agricultural Sciences I.V. Kazakov at the stage of the introduction of these varieties, in a new region.

Statistical processing of research results was carried out by the Program and Methodology for the Study of Fruit, Berry and Walnut Crops (Sedova and Ogoltsova, 1999); the Methodology of Field Experiments (Dospekhov, 1985); the Methodology for the State Variety Testing of Agricultural Crops (Baksheev, 1970); Methodological Guidelines for the Statistical Processing of Yield Data of the State Variety Testing of Agricultural Crops (Peregrudov, 1968); Methods of processing phenological observation data (Ivlev, 2014).

Remontant varieties of raspberries were grown as an annual crop to obtain a late summer-early autumn harvest since the first harvest weakens the plants and delays the onset of ripening of the second, usually more valuable harvest (Kazakov and Evdokimenko, 2006).

Agrotechnics, feeding, and planting care were carried out following the recommendations of the originators of these remontant varieties. Weeding was carried out four times during the growing season. To retain moisture in the soil, the plantings were mulched with peat. Fertilizing with mineral fertilizers was carried out twice with complex nitrogen-phosphorus-potassium fertilizers at the rate of 80 g/m<sup>2</sup>.

Experience scheme:

1. Ruby necklace;
2. Firebird;
3. Elegant;
4. Orange miracle;
5. Hercules (St.).

In the spring of 2020, a collection of 5 varieties of remontant raspberries was additionally laid, such as Nedosyagaemaya (Russian) or Unattainable (English), Bryansk Divo, Polka, Hercules (St) and Atlant.

Experience scheme:

1. Nedosyagaemaya (Russian) or Unattainable (English);
2. Bryansk miracle;
3. Polka;
4. Hercules (St.);
5. Atlas.

Records and observations:

- Meteorological factors;
- Phenological observations (bud opening; beginning of growth of basal shoots; beginning, degree, duration and end of flowering; end of growth of basal shoots);
- The general condition of plants (according to a 5-point system);
- Assessment of disease resistance;
- Study of the characteristics of growth (shoot-forming ability, dynamics of shoot growth, degree of prickling, plant habit).

Temperature conditions in the year of research were typical for the Komi Republic. There were no extreme deviations in the mean daily air temperatures (Komi Center for Hydrometeorology and Environmental Monitoring, 2020). The sums of positive temperatures by month are close to the average long-term indicators, but at the same time, in the active period of plant growth and development, deviations from the norms are also found negative. The amount of precipitation during the growing season exceeded the average long-term data by 66.3 mm, 118% of the norm. The growing season 2020 was characterized by favorable soil and climatic conditions for the growth and development of remontant raspberries, the accumulated effective heat during the season was enough to complete flowering and start ripening of berries.

### **III. RESEARCH RESULTS**

The following observations were carried out on such economic and biological characteristics of remontant raspberry varieties as shoot-forming ability, the general condition of plants, degree of resistance to existing diseases and pests, degree of thorniness.

An earlier start of the growing season in 2020 is due to the rapid thawing of the soil and the early transition of the average daily air temperature in spring through the threshold of 0°C. These phenological observations are presented in Table 1.

**Table 1. Phenological observations of raspberries in 2020, dates**

| Variety        | Shoots begin to grow   | Flowering starts       | Mass bloom                | Ripening starts           |
|----------------|------------------------|------------------------|---------------------------|---------------------------|
| Rubynecklace   | 27 <sup>th</sup> April | 1 <sup>st</sup> August | 31 <sup>st</sup> August   | 31 <sup>st</sup> August   |
| Firebird       | 6 <sup>th</sup> May    | 6 <sup>th</sup> August | 4 <sup>th</sup> September | 4 <sup>th</sup> September |
| Elegant        | 6 <sup>th</sup> May    | 28 <sup>th</sup> July  | 4 <sup>th</sup> September | 2 <sup>nd</sup> September |
| Orangemiracle  | 30 <sup>th</sup> April | 28 <sup>th</sup> July  | 29 <sup>th</sup> August   | 29 <sup>th</sup> August   |
| Hercules (St.) | 27 <sup>th</sup> April | 3 <sup>th</sup> August | 2 <sup>nd</sup> September | 2 <sup>nd</sup> September |

The beginning of the growing season for raspberry plants is considered the beginning of the growth of basal shoots, which was observed in orts from April 27 to May 6. Varieties Ruby Necklace, Hercules (St), and Orange Miracle started growing 6-9 days earlier than other varieties.

The beginning of flowering was noted when 5–10% of flowers blossomed on the plot, the mass was 50–70% of flowers. This phenophase in varieties was observed at the end of the third decade of July and the first decade of August. Earlier flowering was observed in the varieties Orange Miracle and Elegant on 28th July. Raspberry remontant, depending on the variety, entered the full flowering phase from the end of the third decade of August. The beginning of ripening was observed at the end of the third decade of August and the early first decade of September.

The remontant raspberry varieties stand out noticeably against the background of their culture, first of all, by the one-year and rapid development cycle of the aerial part (Sagirova et al., 2016). The shoots of the remontant varieties are much shorter than those of the common raspberry. The height of plants of most remontant varieties is 1.0–1.5 m and rarely reaches 1.8–2.0 m. The fertile soil, with a lot of humus, makes the shoots of remontant raspberries grow too high and require support. And on clayey heavy soil without the introduction of any fertilizers, the shoots do not exceed a height of more than 1.0 m and do not require support. And in fact, and another case, the berries were practically the same size, only the yield in the second case was significantly lower.

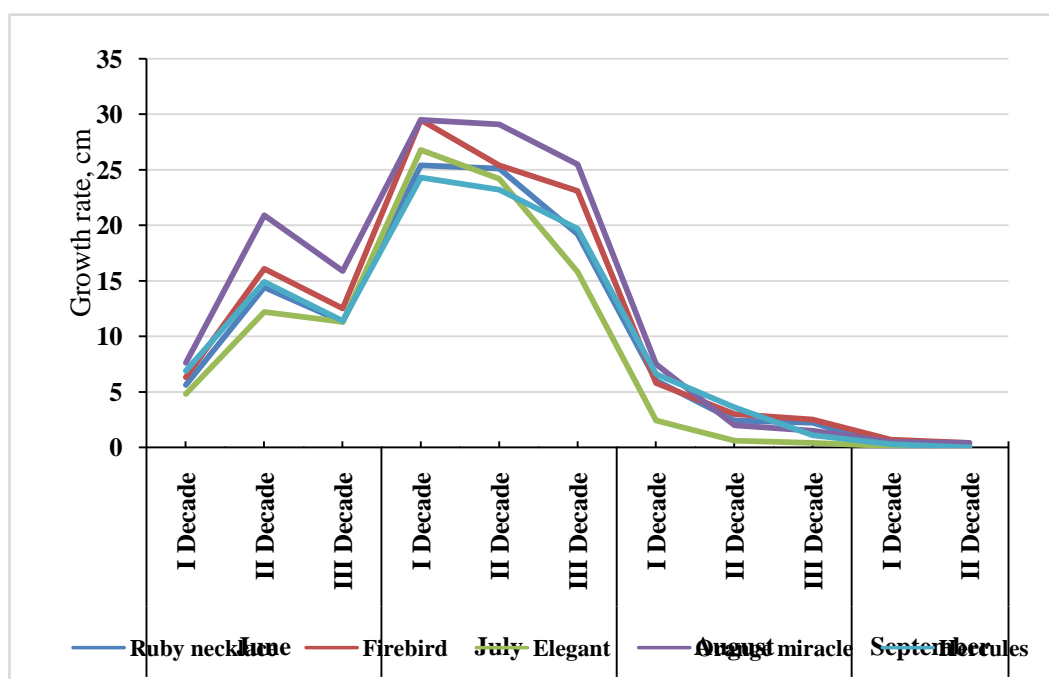
The shoot-forming ability of a plant is the main feature of the variety but largely depends on the type of soil, their fertility, moisture supply, as well as weather conditions. The formation of a certain number of shoots is directly related to the productivity of raspberry plants and is a positive sign of the variety (Sagirova et al., 2016).

Observations have shown that the varieties of remontant raspberries have significant differences in the formation of the total number of shoots, replacement shoots, and root suckers. In the bushes, from 11 to 21 pieces of shoots were formed, a particularly large number of them were found in the Ruby necklace varieties (21 pieces/bush). A smaller number of shoots were distinguished by the varieties Firebird (20 pcs / bush), Orange Miracle (16 pcs / bush), Elegant (15 pcs / bush), and the standard variety Hercules (11 pcs / bush).

Shoot growth dynamics were measured for all plants (typical cultivar) every ten days until the shoot growth stopped changing over the last 2-3 decades. The study of the dynamics of shoot growth, from the date of the appearance of new shoots above the soil surface, showed that, depending on the variety, the plants reached a height of 108.6 cm to 152.6 cm.

The tallest variety turned out to be Orange Miracle (152.6 cm), significantly exceeding the indicators of other varieties with HCP05 = 4.81. The annual growth of raspberries averaged 17 cm in 2020 (Figure 1).

Thorniness is referred to as the main economically valuable trait when evaluating varieties of remontant raspberries for cultivation in industrial and amateur horticulture. For state and industrial testing, preference is given to timeless and low-tine grades of remontant raspberries. The degree of prickling was determined visually in points.



**Fig1. Growth dynamics of remnant raspberry shoots**

According to the thorniness degree, the Firebird variety belongs to the group of strong thorns, when the shoots along the entire length are heavily dotted with hard thorns (3 points).

The group of medium-spiked, when the shoots in the upper part are without thorns or weakly spiny, and in the lower part with strongly pronounced thorniness, represented by the varieties Ruby necklace and Hercules (St) (Table 2).

**Table 2. The thorniness degree of remnant raspberry**

| Variety        | Points (0–3) | Thorniness degree |
|----------------|--------------|-------------------|
| Rubynecklace   | 2            | Medium-spiked     |
| Firebird       | 3            | Spiny             |
| Elegant        | 1            | Weakly spiked     |
| Orangemiracle  | 1            | Weakly spiked     |
| Hercules (St.) | 2            | Medium-spiked     |

The following varieties were attributed to the group of weak spikes, i.e. Elegant and Orange miracle. Weak thorniness is expressed in the absence of single thorns in the upper part of the shoots, and in the lower part of the shoots, there is an average number of hard thorns.

The habitus of remnant raspberries was determined by the direction of growth of shoots in space, height, and thickness of stems, their branching, spreading, upright growth, compactness.

In our experiment, to assess the compactness, in the bush cultivation of raspberries, the following categories were noted: compressed type bush, upright bush, spreading bush (Table 3). The shoots were characterized by their location to the soil surface, the shape of the top, length, branching, evenness, or unevenness in thickness from the base to the top (tapering).

**Table 3. Raspberry plant habitus**

| Variety       | Points (1–5) | Compactness assessment |
|---------------|--------------|------------------------|
| Ruby necklace | 1            | non-compact            |
| Firebird      | 3            | compact                |
| Elegant       | 1            | non-compact            |



|                |   |             |
|----------------|---|-------------|
| Orange miracle | 1 | non-compact |
| Hercules (St.) | 3 | compact     |

Varieties Ruby Necklace, Elegant, Orange Miracle had a spreading bush, erect shoots, arcuate or deviated from the base with drooping tops, converging, with relatively long internodes (1 point).

The varieties Firebird and Hercules were distinguished by the compactness of the bush (3 points). The bushes were classified as erect. Shoots are erect, stronger than the compressed type of bush; with a slightly drooping top; moderately dense, hard, with frequent internodes.

#### IV. CONCLUSION

The climatic conditions of the central region of the Komi Republic in terms of moisture and heat supply in the growing season 2020 were favorable for the growth and development of remontant raspberries.

The studied varieties of remontant raspberry can be divided into two groups according to the timing of the beginning of flowering:

- Medium (Ruby necklace, Elegant, Orange miracle, Hercules) - the beginning of flowering occurs at the end of the third decade of August - the first decade of September;
- Late (Firebird) - flowering begins in the second decade of September.

Repairing cultivars under equal growing conditions formed a different number of shoots. In the bushes, from 11 to 21 pieces of shoots were formed, a particularly large number of them were found in the Ruby necklace varieties (21 pieces/bush). The varieties Firebird (18 pcs / bush), Orange miracle (16 pcs / bush), Elegant (15 pcs / bush), and the standard variety Hercules (11 pcs / bush) were distinguished by a smaller number of shoots. The optimal number of replacement shoots was noted in all varieties (from 4 to 7 pcs / bush), the maximum number of replacement shoots was Ruby necklace (7 pcs / bush).

The tallest variety turned out to be Orange Miracle (152.6 cm), significantly exceeding the indicators of other varieties with HCP05 = 4.81. The second highest varieties were Ruby Necklace, Hercules, and Firebird (132.7–135.8 cm). The smallest growth among the studied varieties was distinguished by the Elegant variety (108.6 cm).

Thus, as a result of research carried out in 2020, varieties with a complex of economically useful traits were identified:

- Variety Ruby necklace - moderate growth of shoots, early onset of ripening, a sufficient level of shoot formation (21 pcs / bush);
- Firebird variety - moderate shoot growth, moderate shoot-forming ability (18 pcs / bush).

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