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Suitability of blue honeysuckle (*Lonicera caerulea* L.) cultivars of different origin for cultivation in the Nordic-Baltic climate

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Abstract. The rising trend of blue honeysuckle has led to the increase in new plantations and berry production in recent years in Nordic-Baltic region, including Estonia. This crop is naturally distributed in the temperate climate zone of Northern Hemisphere. Estonia is also located in the same climate zone, but differs only from warm maritime air. The main aim of this research was to find out cultivars' adaptation to the changing weather conditions regarding winter hardiness, fruit weight, yield and occurrence of secondary flowering. The data was recorded from two closely situated plantations in Polli village, Viljandi County, Estonia. Eighteen cultivars of blue honeysuckle with different origin (Russia, Canada, Poland and Czech Republic) were tested. In 2016, greater winter damage was recorded when compared to the period of 2017–2020 with just marginal damage. In conclusion, the Canadian cultivars ('Borealis', 'Indigo Gem', 'Indigo Treat' and 'Tundra') and Polish 'Duet', presented their best properties and suitability to Estonian climatic conditions.

Key words: edible honeysuckle, fruit weight, *Lonicera caerulea* L., production, secondary flowering, winter hardiness.

INTRODUCTION

Edible honeysuckle (*Lonicera caerulea* L.) also known as blue honeysuckle or Haskap is naturally distributed in Russia and Asia (Chaovanalikit et al., 2004). The berries have been collected for food and used for medical purposes for a long time. However, in Estonia, this crop has gained popularity in recent years. Formerly it was grown solely in home gardens. Recently, an increasing number of producers have established small plantations of blue honeysuckle (the exact statistics is absent). It has gained the appreciation of growers because of their sufficient cold hardiness in our climate and early ripeness of the berries. As there are many cultivars available in nurseries of different origin, appearance and fruit ripening time, therefore it is difficult to select the right cultivar that is productive, but also suitable for variable weather conditions and resistant to other biotic and abiotic stressors.

Despite many advantages of blue honeysuckle, still the suitability of cultivars for cultivation in a changing weather conditions in Estonia needs to be confirmed. For example in the autumn, occasionally occurring warm periods may cause the delay in the process of preparation for winter dormancy of the plants. Therefore, secondary flowering of the plants can be observed (Arus & Kask, 2007). Secondary flowering of edible honeysuckle may occur due to plants' low requirement of chilling hours and on account of fluctuating temperatures in autumn (Kolasin & Pozdnyakov, 1991; Plekhanova et al., 1993; Gerbrandt et al., 2018a). Leonovna (2019) stated that during ten years of research, plants usually started flowering prematurely in October or November, and in some extreme years even ovaries were formed.

In addition, fluctuations in air temperature during the wintertime coming with warmer periods that frequently end with frosts may reduce the bioweight or destroy the whole plant (Lazdiņa et al., 2016). Early growth cessation and leaf drop has been associated with susceptibility to changes of temperature in the winter (Gerbrandt et al., 2018a). More than 30 years ago, the suitability of edible honeysuckle for cultivation in temperate climate was questionable due to early bud break during increased winter temperatures (Plekhanova, 1986). However, at present, the wide selection of different cultivars has changed the viewpoint. The local Japanese species of edible honeysuckle (*L. caerulea* var. *emphyllocalyx*) is considered to be more adapted to moderate climate (Thompson & Barney, 2007) than those used for breeding of the Russian cultivars (Plekhanova et al., 1993). It was reported that other species in the genus of *Lonicera* such as *L. tatarica* L. and *L. maackii* (Rupr.) Maxim. had both phases of exogenous and deep dormancy (Brailko & Gubanova, 2014). The exogenous dormancy lasts for 68–72 days and is followed by 20–23 days of deep dormancy. The trials performed in Ukraine revealed that the exogenous dormancy started in the genus of *Lonicera* from II–III decade of August (Rura & Opanasenko, 2000).

As well as phenological adaption, the appearance and economical parameters act as key factors in terms of fresh consumption. The fruits of blue honeysuckle are quite small, an average weight is ranging from 0.56 to 2.18 g (Gawroński et al., 2014; Gerbrandt et al., 2018b). As it was reported by Arus & Kask (2007) the yield of fully-grown plants of blue honeysuckle in Estonia was rather low (700–2,220 g per bush) compared to mainstream fruit crops like blackcurrant (2,000–6,300 g) depending on the growing sites (Kahu et al., 2009). Still, it was found that phenological adaption had an important role in reaching extremes in fruit weight and yield (Gerbrandt et al., 2018b).

The aim of this research was to compare 18 edible honeysuckle cultivars in order to find out their suitability for Nordic-Baltic climate and cultivation properties in terms of winter hardiness, fruit weight, productivity, yield and occurrence of secondary flowering.

MATERIAL AND METHODS

Experimental site and cultivars

Eighteen edible honeysuckle cultivars originated from Russia ('Amfora', 'Bakcharskij Velikan', 'Lebedushka', 'Leningradski Velikan', 'Morena', 'Moskovskaja 23', 'Nimfa', 'Roksana', 'Tomichka', 'Chulymskaya', Viola', 'Volhova'), Canada ('Borealis, 'Indigo Gem', 'Indigo Treat', 'Tundra'), Poland ('Duet') and Czech Republic

(‘Modry Triumph’) were evaluated from 2016 to 2019. Two experimental plots were established in 2014 with the same cultivars at both locations: (1) cultivar collection of Polli Horticultural Research Centre (58°7’ N, 25°32’E) with three plants of each cultivar per replication for manual harvesting; and (2) Seedri nursery (58°6’ N, 25°33’E) with 30 plants of each cultivar per replication for machine harvesting. Bushes were planted with a spacing of 1.5 m between plants and 3.0 m between rows. Plants were grown in rows mulched with tree bark in Polli, and textile cover in Seedri nursery. In both places no additional irrigation of experimental plants was applied.

Meteorological conditions

Table 1. Weather conditions of Viljandi according to Estonian Weather Service during the experimental years (2016–2020) compared to long-term average (1961–1990)

Month	Mean monthly temperature, °C						Total monthly precipitation, mm					
Year	2016	2017	2018	2019	2020	Long-term average	2016	2017	2018	2019	2020	Long-term average
January		-3.2	-2.2	-5.3	2.5	-4.4		37	40	54	50	62
February		-3.1	-8.3	-0.2	1.0	-5.1		39	23	42	106	43
March		1.1	-3.8	1.2	2.2	-1.0		48	26	55	38	43
April		3.2	6.7	7.3	4.9	5.3		50	49	3	47	36
May		10.3	15.2	10.9		11.3		14	25	52		48
June		13.9	15.6	18.3		14.9		61	61	73		87
July		15.6	20.2	16.0		17.5		79	40	57		83
August		16.3	18.1	16.4		16.1		82	94	65		91
September	12.8	11.9	13.7	11.5		11.0	26	134	108	92		67
October	4.0	5.0	7.2	6.8		6.0	36	113	78	112		81
November	-0.9	2.4	2.4	2.6		0.6	85	60	35	61		64
December	-0.1	0.3	-2.4	1.9		-3.1	45	84	34	68		60

Months of autumn of 2016 were less humid than those of long-term average (1961–1990). However, rainfall in November was 21 mm more than the average. October was two degrees colder than the mean. Overall, the weather from October (2.4 °C) to December 2017 (0.3 °C) was a few degrees colder than in 2016 (-0.9 °C, -0.1 °C). Temperatures in April were lower (3.2 °C) compared to the average (5.3 °C), as of May (10.3 °C), June (13.9 °C) and July (15.6 °C). May was the driest month (14 mm), whereas, in September, the greatest rainfall was recorded (134 mm). Also, October 2017 was very humid (113 mm). However, December of 2017 was considerably warm (0.3 °C) compared to the previous years (-3.1 °C). There was a fluctuation in February 2018. The temperatures in the period from February to March in 2018 were 3.2 °C and 2.8 °C less than the long-term average. On the other hand, the months of April and May and meteorological autumn months were up to 3.9 °C warmer compared to the long-time average. Again, in May 2018 there was a drought with only 25 mm of rainfall, but the highest precipitation (108 mm) was recorded in September. The winter of 2019 occurred earlier, in February the average temperature was warmer (-0.2 °C) than the long-term average (-5.1 °C). Also, meteorological spring months (March and April) were up to 2 °C warmer than the average. The precipitation rate of April in 2019 was extremely low (only 3 mm), but it increased in May (52 mm). There was a 31 mm higher rainfall in October of 2019 when compared to long-term mean. The beginning of 2020 was drastic for plant overwintering. The temperatures in the months of January, February and March did not drop below 0 °C and were fluctuating up to 7 degrees. In February of 2020, the precipitation level was also different from average with the rainfall of more than double (106 mm).

Phenological data

The vegetation period in 2017 started in May. The start of the vegetation period is defined by a period when the temperature stays constantly below 5 °C. The beginning of blue honeysuckle plant growth is defined by the bud burst, which started in March 27th–31th. The beginning of flowering is defined when 5% of the petals of flowers on a single bush is open, and in 2017 cultivars 'Volhova' and 'Nimfa' were the first ones flowering on May 10th. The beginning of flowering was recorded until the 17th of May. On June 13th–25th first fruits started the colouration to blue. First fruits ripened in the middle of June, 15th–July 4th. The earliest ripening cultivar was 'Viola' and the latest 'Duet'.

The vegetation period in 2018 started in April, and the bud break of blue honeysuckle was observed during April 11th–April 21th. Cultivar 'Viola' had the first flowers on April 28th, and the beginning of bloom was recorded until 7th May. The colouration of blue honeysuckle fruits started on May 25th to June 6th. The fruits of blue honeysuckle started to ripen from May 25th to June 30th. Cultivars with the earliest ripening were 'Tomichka' and 'Volhova', their fruits ripened from June 2nd. The ripening of fruits continued until June 16th.

The vegetation period in 2019 started in April, but the bud break in 2019 was observed already from March 22nd to April 13th. The start of flowering was recorded on April 20th–28th. It was found that cultivar 'Nimfa' had the first flowers. The colouration of fruits started from May 30th to June 4th. Fruits started ripening in the II decade of June, 17th–July 1st. Cultivar 'Volhova' and 'Leningradski Velikan' were the earliest and 'Tomichka', 'Tundra', 'Viola', 'Duet' and 'Amfora' the latest ones.

Evaluations and determinations

The evaluation of different parameters was done by using a 9-point ranking scale (1–9) at both experimental plantations as follows: (1) winter hardiness was evaluated from the end of April to the beginning of May depending on the year (1 = dead to the ground; 5 = moderate injury, 40–50% of branches with visible damage; 9 = no injury); (2) secondary flowering was observed visually on the bushes in November (1 = secondary flowering is absent, 5 = secondary flowering is moderate, 9 = very high secondary flowering); (3) productivity per plant was evaluated a week before harvest (1 = very low yield up to 100 g per bush, 5 = moderate productivity with 400–700 g per bush, 9 = very high yield more than 1,000 g).

For determination of average single fruit weight, 50 fruits were weighed and the weight was divided by 50. Yield per bush was calculated as follows: yield for manually harvested bushes - each bush was harvested separately and weighed per bush; yield for machine harvested bushes - all the bushes of each cultivar were harvested and the yield was divided per bush (15 June – 4 July 2017; 2–25 June 2018; 14 June – 1 July 2019). The 'Joanna-4' berry harvester (capacity 0.1–0.15 ha per hour, Weremczuk Ltd, Poland) was used for mechanical harvesting of blue honeysuckle at Seedri nursery. All determinations and evaluations were performed in triplicate.

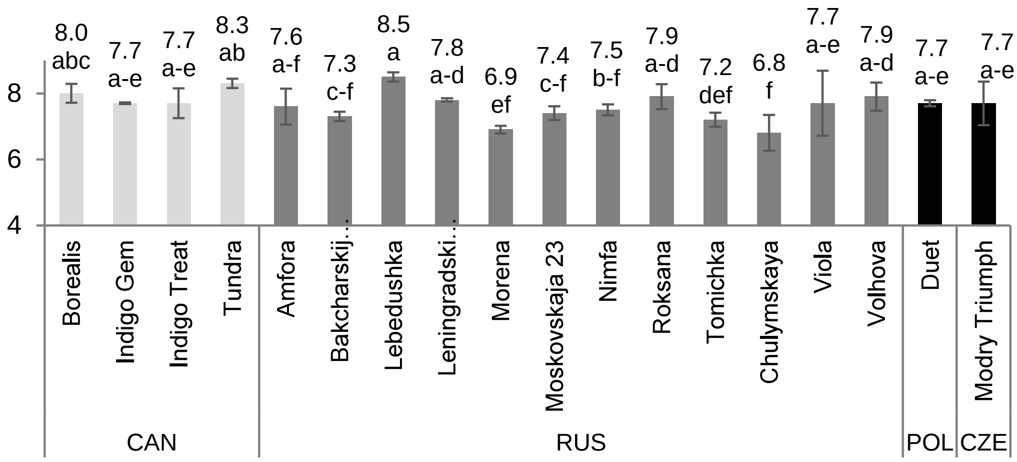
Statistical analysis

Data was expressed as means (± standard deviation - *SD*) in Table and Figures. Results of the fruit weight, productivity and fruit yield of each genotype were analysed using one-way ANOVA in an individual years of investigation and as average for all years of studies. The least significant differences ($LSD\_0.05$) were also calculated.

RESULTS AND DISCUSSION

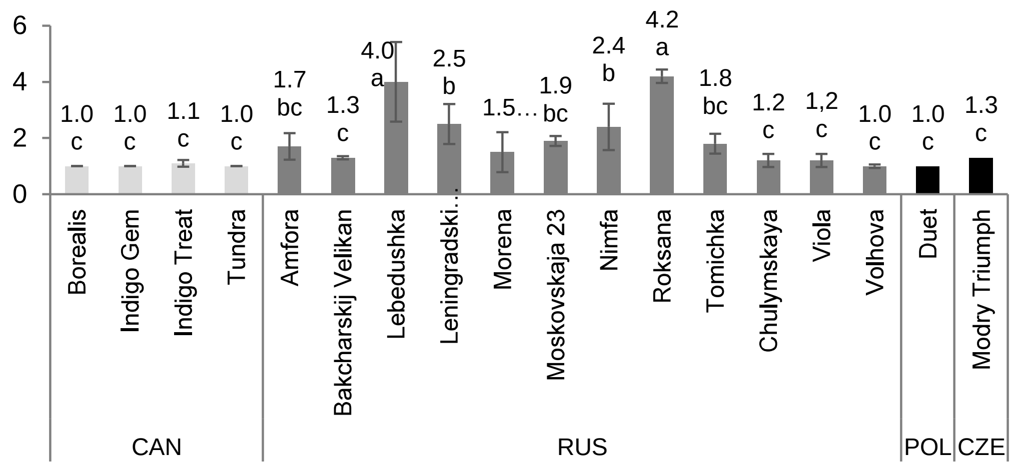
Winter hardiness and secondary flowering

The local climate limits the area of blue honeysuckle cultivation, mainly due to the occurrence of winter damage of plants. The results of winter hardiness showed that over the experimental years (2016–2020), each cultivar had only slight winter damage (8.5–7.6; Fig. 1), this means that some vegetative parts did not survive the winter.



Fugure 1. Average results of winter hardiness of plants of tested edible honeysuckle cultivars in 2016–2020, using 1–9 point ranking scale, 1 = dead to ground, 5 = moderate injury, 9 = no injury. CAN = Canada, RUS = Russia, POL = Poland, CZE = Czech Republic. Different letters (a, b…) indicate significant ($p < 0.05$) differences among cultivars. Data expressed as means (± standard deviation bars on columns).

The least damage was recorded for cultivars of Canadian, Polish and Czech origin. In the group of Russian cultivars, there were more of those that had higher winter injury in comparison with the average injury (7.6). However, in our study, the plants of cultivar 'Chulymskaya' had the highest rate of winter injury (6.8). In the research conducted in Russia, it was observed that plants of 'Leningradski Velikan' was tolerant to low temperatures (Shpitalnaya & Titok, 2016). The study also showed that plants of cultivars 'Nimfa' and 'Morena' were winter hardy, but in our study, some injuries occurred in plants of both genotypes. Although plants of blue honeysuckle can withstand -45 °C (Hummer, 2006), it was concluded that fluctuating temperatures might still damage the plants (Plekhanova et al., 1993). In addition, the precipitation in November of 2016, October 2017 and 2019 was above average. Therefore, somewhat higher rainfall in the autumn of these experimental years could have interrupted the plants' entrance to winter dormancy by enhancing their growth instead. The latter may harm the plants due to suitable temperatures for their growth causing winter injuries after a sudden temperature drop (Gerbrandt et al., 2018a). During December of 2016, 2017 and 2019, the temperatures were higher than usual. The very exceptional time interval was 2019/2020 when there were small fluctuations and the temperature stayed above zero. In conclusion, it seemed that plants of cultivars from Russian origin were more prone to winter damage when compared to the group of Canadian ones and others. It was also determined that the Canadian cultivars with Japanese blue honeysuckle species in their pedigree were most adapted to moderate temperate climate (Thompson, 2006).

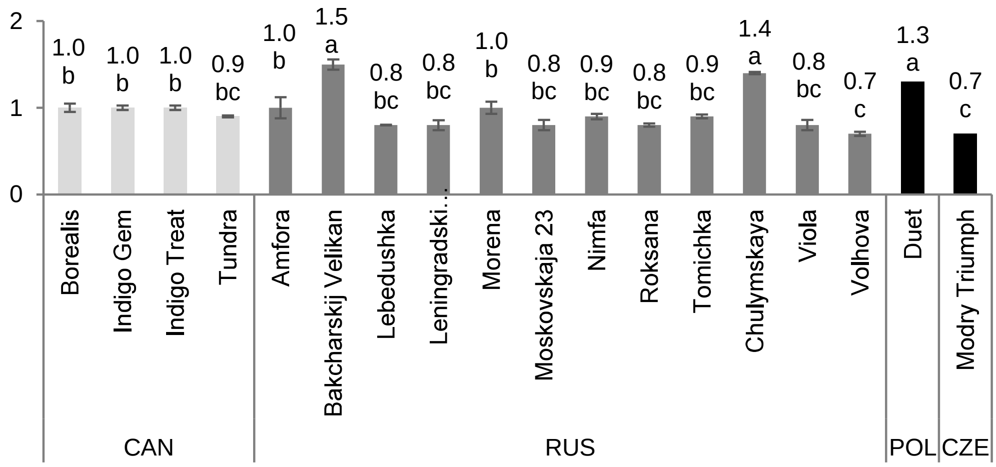


Fugure 2. Average results of the secondary flowering of plants of tested edible honeysuckle cultivars in 2016–2019, using 1–9 point ranking scale; 1 = secondary flowing is absent, 5 = secondary flowering is moderate, 9 = very high secondary flowering. CAN = Canada, RUS = Russia, POL = Poland, CZE = Czech Republic. Different letters (a, b…) indicate significant ($p < 0.05$) differences among cultivars. Data expressed as means (± standard deviation bars on columns).

The secondary flowering of blue honeysuckle plants in the autumn is the next important concern, as it may decrease the next years' yield (Gerbrandt, 2017). During our evaluations in the years of 2016–2019, average results of secondary flowering of tested cultivars varied between 1.0 and 4.2 points (Fig. 2). Generally, it could be seen that cultivars of Russian origin were more subjected to the secondary flowering (up to 4.2 points) than cultivars from Canada and another origin, which nearly did not have any flowering in the autumn (up to 1.3 points only). Plants of cultivars: 'Roksana' (4.2) and 'Lebedushka' (4.0) had the highest rate of the secondary flowering. The moderate rate of autumn flowering was observed on plants of cultivars: 'Nimfa' and 'Leningradski Velikan' (2.4 and 2.5, respectively). The similar results for these previously mentioned cultivars were also recorded earlier in Minsk, Belarus (Firsova et al., 2019) and in the oblast of Kirov, Russia (Shpitalnaya & Titok, 2016). The secondary flowering was absent in the plants of Canadian cultivars 'Borealis', 'Indigo Gem', 'Tundra', Russian origin 'Volhova' and Polish cultivar 'Duet' did not show any signs of late flowering over the experimental years. In Russia (oblast of Tambov), the occurrence of secondary flowering was observed on the plants of different blue honeysuckle cultivars in the warm and dry conditions in autumn (Kirina, 2010). In our study, the favourable weather conditions for the secondary flowering were observed in the years of 2016 and 2018. In 2016, the phenological autumn months (September and October) had up to 45 mm less rain, and the air temperature in September was 1.8 °C warmer than the long-term average. In 2018, quite warm temperatures were recorded in September and October with 2.7 and 1.2 °C more, respectively, and with up to 29 mm less precipitation in November when compared to the long-term mean.

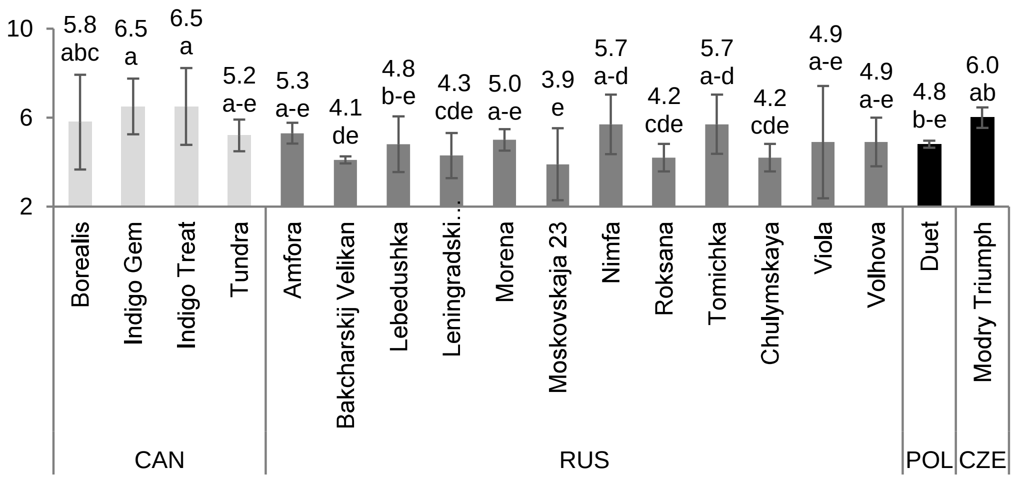
Fruit weight, productivity and yield

The fruit weight is an important characteristic in terms of fresh fruit consumption. Fruit size of blue honeysuckle can significantly differ by cultivar. The average fruit weight of the tested cultivars varied from 0.7 to 1.5 g (Fig. 3). It was calculated a 2.14-fold difference between the average highest and lowest fruit weight among evaluated cultivars. Results obtained in our study were in an agreement with those of Gawroński et al. (2014). 'Bakcharskij Velikan', 'Chulymskaya' and 'Duet' had the highest fruit weight (1.5 g, 1.4 g and 1.3 g, respectively). In contrast, other studies conducted in Poland recorded a high range of fruit weight for 'Duet' (1.4–1.9 g), (Małodobry et al., 2013; Gawroński et al., 2014). In our study, smaller fruit weight of tested cultivars may be because no additional irrigation system was used for plants in the experimental field. According to Nowakowski et al. (2019) irrigation of plants increased fruit size and weight of Canadian originated cultivars, which had fruit weight of 1.0 g or close to it. These results were similar to those obtained in Canada with cultivars 'Borealis', 'Tundra' and 'Indigo Gem' (1.0 g, 1.0 g, 1.0 g) (Gerbrandt, et al., 2018b). Weather conditions during fruit development can have an impact on fruit weight (Bożek, 2012). Lower temperature than the long-term mean in 2017 and quite high rainfall in 2019 could have had an important impact on fruit weight. Also, the fruit set depends highly on pollinators and the lack of pollinating insects can lead to poor fruit set (Bożek, 2012).



Fugure 3. Results of average fruit weight (g) of tested edible honeysuckle cultivars in 2017–2019. CAN = Canada, RUS = Russia, POL = Poland, CZE = Czech Republic. Different letters (a, b…) indicate significant ($p < 0.05$) differences among cultivars. Data expressed as means (± standard deviation bars on columns).

The lowest average fruit weight below 1.0 g was found in Czech cultivar 'Modry Triumph' (0.7 g) and Russian cultivar 'Volhova' (0.7 g). Somewhat higher average fruit weight (0.9 g) of cultivar 'Volhova' was found in Ukrainian research (Leonovna, 2019). The average fruit weight of 'Amfora' (1.1 g) in our study was consistent with that obtained by Zaripova et al. (2019). Nevertheless, there were no significant differences in the fruit weight among other cultivars of Russian origin 'Viola', 'Leningradski Velikan', 'Lebedushka', 'Roksana', 'Moskovskaja 23', 'Tomichka' and 'Nimfa'. Our results of fruit weight for 'Leningradski Velikan' ranged from 0.8 to 1.2 g in investigated years and were in an agreement with those reported by Shpitalnaya & Titok (2016). In a study conducted in Estonia by Arus & Kask (2007) recorded a similar fruit weight for cultivars 'Roksana' and 'Tomichka' (0.9 g and 0.8 g, respectively). Slightly higher, but comparable results of fruit weight of 'Morena' and 'Nimfa' (1.0–1.5 g and 0.8–1.0 g, respectively) were obtained in two independent studies conducted in Minsk (Belarus) and Republic of Bashkortostan (Russia) (Shpitalnaya & Titok, 2016; Zaripova et al., 2019). Somewhat higher fruit weight was presented in the studies conducted in Belarus and Russia showing dependency on the location of the plantation. In our study, lower fruit weight compared to the results of other authors might be related to insufficient moisture conditions occurring in most of the experimental years. In addition, the temperatures during fruit ripening increased in May 2018 and June 2019, respectively 3.9 and 3.4 °C higher than the long-term mean.



Fugure 4. Results of average fruit productivity per bush of edible honeysuckle tested cultivars in 2017–2019, using 1–9 point ranking scale; 1 = very low yield, 5 = moderate productivity, 9 = very high yield. CAN = Canada, RUS = Russia, POL = Poland, CZE = Czech Republic. Different letters (a, b …) indicate significant ($p < 0.05$) differences among cultivars. Data expressed as means (± standard deviation bars on columns).

The fruit productivity of blue honeysuckle is considerably low. In the need for profitable production, it is essential to grow high yielding cultivars. Evaluated cultivars of blue honeysuckle had low to moderate productivity per bush, the scores ranged from 3.9 to 6.5 which corresponds to the 400–700 g per bush (Fig. 4). The highest score of fruit productivity was recorded for Canadian cultivars 'Indigo Gem' and 'Indigo Treat', but there were no significant differences when compared to 'Modry Triumph', 'Borealis', 'Tomichka', 'Nimfa', 'Amfora', 'Tundra' and 'Morena'. The lowest productivity was found for 'Bakcharskij Velikan' (4.1) and 'Moskovskaja 23' (3.9). The weather could have had an impact on the productivity of the tested cultivars, as extremely warm temperatures and low precipitation were recorded in May 2018. Again, if there had been an additional irrigation system, it could have had a positive effect on yield as reported by Nowakowski et al. (2019).

One of the most important reasons which could increase the production acreages of blue honeysuckle in Estonia is making the fruit harvesting more efficient by using the mechanical harvester. Still, in our study, the fruit yield harvested manually was much higher when compared to mechanical harvesting, except for cultivar 'Viola' (Table 2). Lower yield of mechanical harvesting may be due to the losses of berries which can be related to the design of the machine (Casamali et al., 2016). Moreover, the efficiency of mechanical harvest depends on the shape of the bush, berries should be easily detached and the ripening period should be concentrated (Dale et al., 1994). The yield of hand-harvested fruits of the tested cultivars ranged widely from 166 to 1,883 g per plant (Table 2). The lowest hand-harvested yield was recorded for cultivar 'Viola' (166 g), but there were no significant differences among the other cultivars: 'Leningradski Velikan', 'Chulymskaya', 'Bakcharskij Velikan', 'Modry Triumph', 'Duet', 'Moskovskaya 23', 'Nimfa' and 'Roksana'. Hand-harvested fruit yields of Canadian cultivars were significantly higher, mostly due to their larger fruit weight. In our experiment 'Indigo Gem' appeared to be the highest yielding cultivar (hand-harvested), but there were no significant differences among the following cultivars: 'Amfora', 'Indigo Treat', 'Tundra' and 'Morena'. In our study, the average fruit yield of cultivar 'Duet' obtained by manual harvesting was 629 g per plant. It was reported that 3–4-year-old plants of 'Duet' produced yield from 718 to 1,560 g in Polish conditions (Małodobry et al., 2013; Gawroński et al., 2014). Other authors have reported the average fruit yield of blue honeysuckle in the range from 1,100 g to 5,000 g per bush (Hummer, 2006; Zavalishina et al., 2017), although in Estonia the average yield of this crop was significantly lower, 700–2,220 g per bush (Arus & Kask, 2007). Presumably, these differences can be related to the climatic conditions and geographical areas selected for cultivation of blue

Table 2. Fruit yield of manually and mechanically harvested blue honeysuckle cultivars in average of two experimental years (2018–2019), g per plant

Country of origin	Cultivar	Manual harvesting	Mechanical harvesting
Canada	Borealis	957^{cdef}	625^{a}
	Indigo Gem	1,883^{a}	584^{ab}
	Indigo Treat	1,569^{abc}	293^{a-e}
	Tundra	1,523^{abc}	366^{a-e}
Russia	Amfora	1,639^{ab}	530^{abc}
	Bakcharskij Velikan	580^{efg}	254^{b-e}
	Lebedushka	1,184^{b-e}	258^{b-e}
	Leningradski Velikan	459^{fg}	120de
	Morena	1,307^{a-d}	406^{a-e}
	Moskovskaja 23	655^{efg}	130de
	Nimfa	660d^{efg}	209^{cde}
	Roksana	737d^{efg}	372^{a-e}
	Tomitchka	1,159^{b-f}	305^{a-e}
	Chulymskaya	536^{efg}	275^{a-e}
	Viola	166^{g}	209^{cde}
	Volhova	966^{cdef}	274^{a-e}
Poland	Duet	629^{efg}	473^{a-d}
Czech Rep.	Modry Triumph	560^{egf}	105^{e}

honeysuckle. In general, the fruit weight, yield and productivity tend to be higher in warmer climatic conditions.

The average fruit yield of mechanically harvested blue honeysuckle cultivars was low and ranged from only 105 to 625 g per plant (Table 2). In our study, the highest yield was recorded for Canadian cultivar 'Borealis' (625 g per plant) and there were no significant differences in comparison to 'Indigo Gem', 'Amfora', 'Duet', 'Morena', 'Roksana', 'Tomichka', 'Chulymskaya' and 'Volkova'. The lowest fruit yield was harvested from a cultivar of Czech origin 'Modry Triumph' (105 g). The average fruit yield of all mechanically harvested cultivars were generally significantly lower when compared to manual harvesting. In order to apply the mechanical harvesting technology, cultivars should be selected according to their suitability for that purpose.

CONCLUSIONS

The current research represent the results of the winter hardiness, secondary flowering, fruit weight, productivity and fruit yield of 18 blue honeysuckle cultivars evaluated in the Nordic-Baltic climate region. Russian cultivars 'Chulymskaya', 'Roksana', 'Moskovskaja 23' and Czech cultivar 'Modry Triumf' did not perform well in these conditions. The Canadian cultivars revealed their better suitability for the Nordic-Baltic climate during the experimental years of 2016–2020 at Polli Horticultural Research Centre and Seedri nursery, Estonia. The prospective blue honeysuckle cultivars of interest are Canadian origin 'Borealis' and 'Tundra', Russian origin 'Volhova' and Polish origin 'Duet'. Plants of these cultivars presented good winter hardiness, low occurrence of secondary flowering, large fruits and sufficient productivity with high yield. Based on the provided results, these cultivars can be recommended for growing in the changing climate of Estonia. However, further investigations need to be done on flower pollination, plant resistance to pests and diseases, ripening time and fruit biochemical composition of cultivars in order to gain additional information for the purpose of cultivation and fruit quality of this crop.

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