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Honey yield conditions and characteristics of honeys in the south of the Far East of Russia

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Abstract. The article presents the characteristics of honey yield conditions and the quality of honey in the south of the Far East of Russia. The intensity of nectar production by plants in the active period of the beekeeping season is determined. The quality of the produced honey is estimated. The dominant honey plants in different seasons of the year have been established. The melliferous vegetation is rich and diverse and it allows to obtain the yield of marketable honey up to 61.6 kg per one bee colony during the research period. The main honey plant of Primorsky Krai is *Tilia* L. Its pollen contribution can reach 86.7% of the total number of pollen grains in the honey. Moreover, it is present in almost all honey samples. Among the secondary honey plants, the most valuable are *Lespedeza bicolor* Turcz., *Fagopyrum esculentum* Moench., species of genus *Polygonum* L. and of the *Araliaceae* family. Honey gathered at the same time in various areas of the region differs in pollen content of dominant honey plants significantly. Pollen of endemic plants are present in the honey samples, and it makes it possible to identify "Primorsky Honey" as highly reliable.

1. Introduction

Honey has a complex composition which is determined mainly by its botanical origin. At the same time, monofloral honeys gathered in different regions differ both in organoleptic and physico-chemical parameters. For example, linden (*Tilia* sp.) honey derived in the Southern District of Russia differs from that one gathered in the Central District or the Far East in taste, color, smell, the content of enzymes, reducing sugars, and other indicators. In this case, differences in the quality indicators of honey can be observed not only in various regions but also in the same region. It is connected both with the species diversity of *Tilia* L. and the composition of the melliferous flora, which blooms simultaneously with the dominant honey plant [1, 2].

The main and secondary melliferous plants, which depend on the natural and climatic conditions of the area are characteristic for different regions. So such honey plants as *Chamerion angustifolium* (L.) Holub., *Trifolium pratense* L., *Salix* L. and representatives of the *Apiaceae* and *Asteraceae* families dominate in the Tver region [3]. In the Krasnodar Territory honey is produced from *Castanea sativa* Mill., *Helianthus annuus* L., *Tilia platyphyllos* Scop., *Robinia pseudoacacia* L., *Gleditsia* J. Clayton [4, 5]. Bashkiria is famous for its linden honey [6].



The honey derived in the south of the Far East of Russia has not been studied practically yet. In addition, the honey plants of Primorsky Territory are represented by a large number of endemic species, the pollen of which was not described at all. Important endemic, medicinal and relict plant species of the Far East / Primorsky Krai in honey production are *Phellodendron amurense* Rupr., *Kalopanax septemlobus* (Thunb.) Koidz., *Oplopanax elatus* (Nakai) Nakai, *Actinidia giraldii* Diels, *Sanguisorba magnifica* Schischk. et Kom. and others.

Based on the foregoing, the aim of the work was to characterize the honey yield conditions and the quality of honey in the south of the Far East of Russia. Research objectives were to determine the intensity of nectar production by plants during the active period of the beekeeping season, to assess the quality of it, to determine dominant honey plants in different seasons of the year.

2. Materials and methods

The work was carried out in the conditions of the Federal State Budget Institution of Higher Education "Primorskaya State Academy of Agriculture" on the Educational Scientific and Industrial Production Apiary located in the village of Muraveika, Anuchinsky district, Primorsky region (Russia). The intensity of nectar production by plants was studied indirectly by the nectar delivered into the hive, by the duration of the main honey gathering and the yield of marketable honey per bee colony. Daily delivery of nectar was recorded by the change in the mass of the control hive. The duration of honey gathering was determined by the beginning and the end of the flowering of linden and the cessation of nectar.

During 10 years, an annually average sample of honey produced on the apiary was selected and then examined for compliance with the sample of the State Standard (GOST) in the Testing Laboratory of the Federal State Institution "Primorskaya Interregional Veterinary Laboratory" of the town of Ussuriysk.

In addition, during the past three years, 64 honey samples have been taken from different regions of the Primorsky Territory in various periods of the beekeeping season. Samples of honey were derived in Anuchinsky, Chernihiv, Kirov, Chuguevsky, Spassky, Khankaysky, Khasansky, Khorolsky, Shkotovsky, Oktyabrsky, Pogranichny districts and Ussuriysky urban area. These samples were studied for botanical affiliation in the laboratory of the Academy.

Botanical origin was determined by pollen grains in honey according to Almeida-Muradian et al. [7]. When identifying species affiliation of plant pollen, available literature was used [8-10]. In addition, reference preparations were made from herbarium plant samples according to the method of R.P. Wodehouse [11].

3. Results and discussion

The vegetation of Primorsky Krai is represented by more than 2000 plant species which are used by bees to gather nectar and pollen [12]. The most valuable spring honey plants are *Salix* L. (25 species), *Acer* L. (9 species), *Lonicera* L. (8 species), *Actinidia* L. (4 species), *Rubus* L. (3 species), *Spiraea* L. (9 species), *Phellodendron amurense* Rupr., *Padus maackii* (Rupr.) Kom., *Vitis amurensis* Rupr., *Schisandra chinensis* (Turcz.) Baill. and many others [13]. These plants are used by bees for growth and development. During this period marketable honey is derived very rarely and in small quantities.

In this region the honey is mainly gathered in July, during the flowering period of *Tilia* L. According to various data their species diversity is represented by 3 to 8 species [10, 12-14] They bloom alternately, with an interval of 5-7 days from the end of June to the end of July. In different years the flowering period was changing and the nectar flow (table 1) varied from 10 kg (2015) to 17 kg (2014) in the Educational Scientific and Industrial Production Apiary.

As a rule, in the early days of *Tilia* L. flowering, a nectar flow was insignificant and on July 1-3 its weight was from 1.5 to 5 kg. Then the amount of nectar started to increase and on July 6-8 it reached the weight of 6-12 kg. The highest indicators of the control hive were observed on July 12-15 during the study period.

Sometimes, honey gathering comes to the end early, and nectar flow was insignificant. For example, in 2017 the highest nectar flow was observed on July 10 and its weight was 11 kg. It occurs that high flow was preserved for a long time and was high up to the end of July. On July 18 in 2012 the weight of the control hive increased to 15.5 kg per day. *Tilia* L. flowering period lasted until July 28, and on the 25th the nectar delivery reached 10 kg. According to our data in different years the duration of the main honey yield was from 16 (2017) to 28 days (2012, 2016).

Table 1. Honey yield conditions by the Educational Scientific and Industrial Production Apiary in 2010-2019.

Year	Produced marketable honey for 1 bee family (kg)	The maximum daily delivery of nectar (kg)		Duration of the main honey yield (days)
		In July	in August	
2010	61.6	14.0	1.5	27
2011	57.3	14.0	4.0	25
2012	61.1	15.5	4.5	28
2013	50.0	17.0	4.0	18
2014	53.5	17.0	7.0	18
2015	36.9	10.0	5.5	17
2016	51.4	14.0	2.5	28
2017	44.5	11.0	4.5	16
2018	48.0	12.0	0.5	18
2019	65.4	15.0	5.0	21

The results were coordinated with our previous studies [15], according the duration of honey yield was 14-26 days, and the maximum of nectar flow reaches 12-23 kg. Kodes L.G. and Popova I.V. [16] noted that the period of *Tilia* L. nectar production may be equal to 16-23 days. The highest nectar production was observed on July 10-14 and its weight was 9.5-15.5 kg.

The duration of the main honey yield was influenced by weather conditions. When it rains, especially when rains were accompanied by thunderstorms, the release of *Tilia* L. nectar ceases.

At the end of *Tilia* L. flowering in the taiga zone of the Primorsky Territory, when representatives of the *Araliaceae* family bloom, four species as *Eleutherococcus senticosus* (Rupr. et Maxim.) Maxim., *Eleutherococcus sessiliflorus* (Rupr. et Maxim.) S.Y. Hu, *Kalopanax septemlobus* (Thunb.) Koidz. and *Aralia mandshurica* Rupr. et Maxim. are of greatest interest for beekeepers [17]. In the forest-steppe zone *Lespedeza bicolor*, 42 species of *Polygonum* L., 5 species of *Sanguisorba* L. and other melliferous plants, among which there are narrow-local endemics, produce a nectar plentifully [18, 19]. Such important melliferous plants as *Fagopyrum esculentum* Moench., *Phacelia* Juss. and *Brassica napus* L. are cultivated in the region. On the experimental apiary all these honey plants contributed to the production of marketable honey from 36.9 kg (2015) to 61.6 kg (2010) per bee colony.

The quality of honey in our country is regulated by the State Standard [20], according to which natural honey must have a diastase number of at least 8 Gothe units. The mass fraction of water cannot exceed 20%, the content of saccharose is limited to 5%, the amount of reducing sugars must exceed 65%. Hydroxymethylfurfural (HMF) is determined by qualitative reaction and quantitative method. With a content of this substance up to 16%, the qualitative reaction will be negative. The permissible content of HMF is 25 mg.

During the entire period of research, honey produced on the Educational Scientific Industrial Production Apiary was of high quality (table 2). From year to year the mass fraction of reducing sugars undergo the least changes from 80.10±6.41% (2016) to 88.40±0.70% (2011). The enzymatic activity of honey is from 8.80±0.70 (2010) to 18.45±1.00 (2014) expressed in Gothe's scale units.

The content of HMF in honey was not determined by a quantitative method until 2013, it was limited only to a qualitative reaction. From 2014 this indicator varies from 0.31 ± 0.09 to $3.84 \pm 1.08\%$.

A botanical analysis of the honeys showed that pollen grains of *Acer* L. prevailed in the samples of honey derived in May-June 39.4-47.5%. In addition, *Phellodendron amurense* Rupr. pollen was present in large quantities - 5.6-23.5% and of *Actinidia* Lindl. - 17.0-19.8%. Pollen grains of *Schisandra chinensis* (Turcz.) Baill., *Taraxacum* Wigg., *Trifolium repens* L., *Lygustrina amurensis* Rupr. were also present.

Table 2. Quality of honey produced on by the Educational Scientific Industrial Production Apiary.

Year	Mass fraction of HMF (%)	Mass fraction of water (%)	Mass fraction of reducing sugars (%)	Mass fraction of reducing saccharose (%)	Diastase number (Gothe units)
2010	-	19.6 ± 0.14	86.40 ± 0.70	2.50 ± 0.70	8.80 ± 0.70
2011	-	19.8 ± 0.14	88.40 ± 0.70	2.50 ± 0.70	8.90 ± 0.70
2012	-	19.2 ± 0.50	87.35 ± 0.30	3.27 ± 0.30	9.10 ± 0.30
2013	-	18.8 ± 0.45	85.00 ± 3.40	3.91 ± 0.27	10.80 ± 0.60
2014	3.84 ± 1.08	19.5 ± 0.78	85.30 ± 6.82	4.28 ± 0.48	18.45 ± 1.00
2015	0.46 ± 0.13	19.2 ± 0.58	87.96 ± 7.04	4.83 ± 0.53	15.10 ± 1.70
2016	0.31 ± 0.09	19.4 ± 0.78	80.10 ± 6.41	3.58 ± 0.39	9.00 ± 1.00
2017	1.50 ± 0.40	19.0 ± 0.75	84.68 ± 6.78	3.08 ± 0.33	9.20 ± 1.00
2018	2.70 ± 0.75	18.2 ± 0.70	85.70 ± 6.84	3.66 ± 0.40	13.01 ± 1.20
2019	3.01 ± 0.95	18.7 ± 0.75	85.12 ± 6.32	3.88 ± 0.46	11.40 ± 1.70

The pollen of various honey plants was represented in the honey samples differently (table 3). The main honey plant of Primorsky Krai is *Tilia* L. The share of its pollen can reach 86.7% of the total amount of pollen grains in honey. Moreover, it was present in almost all honey samples (in 58 samples).

An important honey plant of secondary honey gathering is *Lespedeza bicolor*. Its pollen was found in 28 honey samples, its amount varied from 6.4 to 79.3%. In 2019, *Sanguisorba* L. often dominated in honeys gathered in August. The share of its pollen reached 53.5%.

Table 3. The share of pollen grains of individual honey plants in honeys gathered in July - August 2017-2019.

Plant	The share of pollen in the samples (%)	The number of samples with pollen
<i>Tilia</i> L.	single – 86.7	58
<i>Lespedeza bicolor</i> Turcz.	6.4-79.3	28
<i>Sanguisorba</i> L.	single – 53.5	28
<i>Fagopyrum esculentum</i> Moench	9.1-25.4	5
<i>Brassicaceae</i>	single – 4.8	5
<i>Trifolium pratense</i> L.	single – 3.6	31
<i>Polygonum</i> L.	single – 20.8	14
<i>Caryophyllaceae</i>	single – 4.1 – 62.7	17
<i>Vicia</i> L.	single – 4.0	43
<i>Apiaceae</i>	single – 3.1	34
<i>Araliaceae</i>	single – 32.9	9
<i>Phacelia</i> Juss.	1.8-20.6	3

Pollen grains of *Trifolium pratense* L. (in 31 samples), *Vicia* L. (in 43 samples) and *Apiaceae* (in 34 samples) were detected frequently in Primorsky Krai honeys, but their share in the total amount of pollen was small, not more than 4.0%. *Caryophyllaceae* pollen (in 17 samples) was quite common also in these honeys. Along with that, their content ranged from single grains to 4.1%. In one of the samples the *Caryophyllaceae* pollen dominated and was of 62.7%.

Rarely, pollen grains of *Fagopyrum esculentum* (in 5 samples) and *Araliaceae* (in 9 samples) were found in the samples studied, reaching 25.4 and 32.9%, respectively. It should be noted, side by side that *Tilia* L. pollen grains were present in large quantities (21.7-32.4%). This may indicate the simultaneous flowering of these honey plants. The content of honey plant pollen varies in different districts of the region. In addition, in the same area in different years the proportion of dominant honey plants can vary greatly (figure 1).

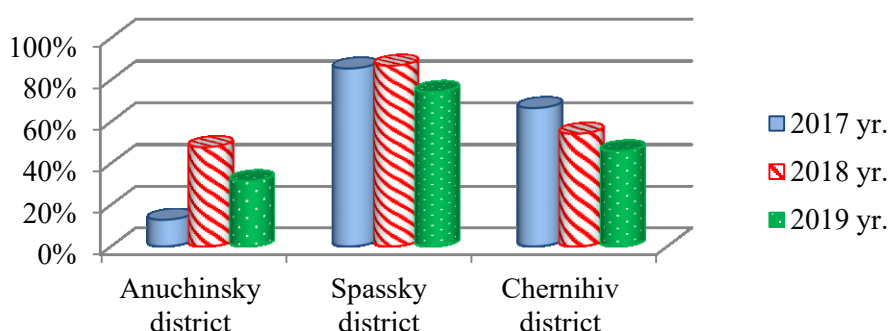


Figure 1. The share of *Tilia* pollen in honeys derived in the same area in 2017-2019, on the example of Anuchinsky, Spassky and Chernihiv districts.

Consistently high content of *Tilia* L. pollen was noted in honeys of Spassky district (74.2-86.7%). In some years in Anuchinsky, Chuguevsky, Mikhailovsky districts the share of *Tilia* L. pollen can be very low. In the Chernihiv district its highest share was observed in 2017 (66.7%). It should be pointed out that in honey gathered at one time in different apiaries of this region, the pollen content of the dominant honey plant can vary greatly. Fluctuations of this indicator make up over 20% (42.3-66.5%).

A similar tendency was observed in honeys gathered in August (figure 2).

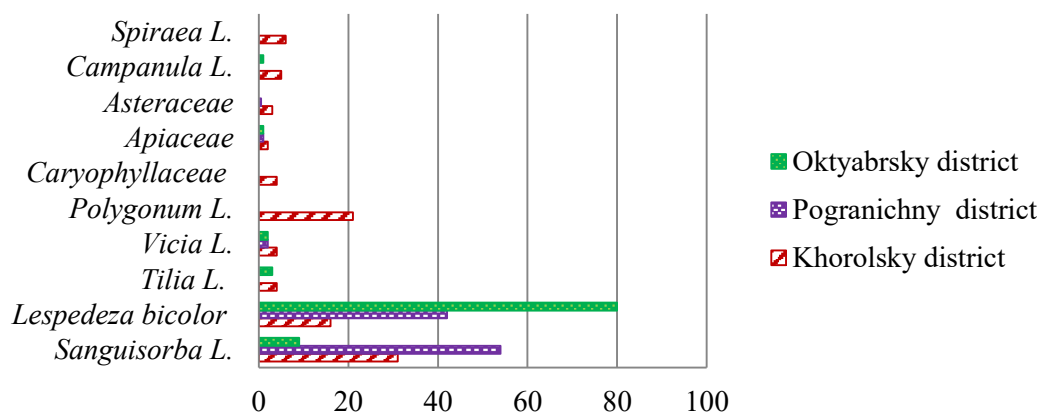


Figure 2. The pollen content of various plants in honeys, evidence from Oktyabrsky, Pogranichny and Khorolsky districts in 2019.

Moreover, in different districts of the region, various honey plants appeared to be dominant.

Honey from the Khorolsky district should be referred to plurifloral honey. It has a high content of three honey plants: *Sanguisorba* L. (30.7%), *Polygonum* L. (20.8%) and *Lespedeza bicolor* (16.4%). In the Oktyabrsky district honey was obtained also (the share of *Lespedeza bicolor* was 79.6%). In the Pogranichny districts *Sanguisorba/Lespedeza* honey was gathered; the total nectar content of these two honey plants was 96%.

4. Conclusion

Summarizing the above, it should be noted that the melliferous vegetation is rich and varied in Primorsky Krai (Territory). It allowed to derive the yield of marketable honey per one bee colony up to 61.6 kg during the research period. The duration of the main honey yield depends largely on weather conditions and was from 16 to 28 days in June to August at the Primorsky Territory.

The main honey plant occurring in Primorsky Krai is *Tilia* L. The share of its pollen can reach 86.7% of the total amount of pollen grains in honey. Moreover, it was present in almost all samples of honey. Honey gathered in various districts of the region at the same time differed greatly from each to another in the pollen content of dominant honey plants.

All honey samples contained pollen grains of endemic plants, and “Primorsky Honey” can be characterized with a high degree of certainty. The presence of a large number of endemic, medicinal and relic plants among honey plants in Primorsky Krai makes our honey unique. Its composition and properties require further studies.

References

- [1] Brandorf A Z, Ivoilova M M, Novikova L V, Ustyuzhanin I A, Moreva L Ya and Ovchinnikova M A 2019 The evaluation of linden honey of different geographical origin *Beekeeping* [in Russian - Pchelovodstvo] **2** 53-55
- [2] *Apis mellifera mellifera* L. into development strategies world of beekeeping: monograph ed A Z Brandorf and M M Ivoylova 2019 (Kirov: FARC North-East) pp 151-154
- [3] Mannapov A G, Antimirova O A and Legochkin O A 2019 Botanical features of Tver honey *Beekeeping* [in Russian - Pchelovodstvo] **10** 49-51
- [4] Moreva L Ya, and Ovchinnikova M A 2017 Monofloral and polyphloral honey of the southern of Russia *Beekeeping* [in Russian - Pchelovodstvo] **4** 54-55
- [5] Ovchinnikova M A 2018 Pollen analysis of honey of the Krasnodar Territory *Beekeeping* [in Russian - Pchelovodstvo] **4** 50-52
- [6] Abdulgazina N M, Yumaguzhin R G, Abdulgazina N M and Kurmanov F G 2015 Flora specialization of bees in the mountain and forest zone of Bashkiria *Beekeeping* [in Russian - Pchelovodstvo] **5** 28-29
- [7] de Almeida-Muradian L B, Barth O M, Dietemann V, Eyer M, da Silva de Freitas A, Martel A-C, Marcazzan G L, Marchese C M, Mucignat-Caretta C, Pascual-Mate A, Reybroeck W, Sancho M Teresa and Sattler J A G 2020 Standard methods for *Apis mellifera* honey research *Journal of Apicultural Research* **59**(3) 1-62 doi: 10.1080/00218839.2020.1738135
- [8] Karpovich I V, Drebezgin E U, Elovikova E A, Legotkina G I, Zubova E N, Kuzyaev R Z and Khismatullin R G 2015 *Pollen atlas* (Yekaterinburg) p 320
- [9] *Atlas of spores and pollen of some modern plants of the Far East* ed N D Mchedlishvili 1971 (Khabarovsk) p 85
- [10] Bolotnikova M D and Gorovaya M T 1978 Revisiting the species of the genus *Tilia* growing in the south of the Far East *Palynological studies in the Far East* (Vladivostok) pp 37-45
- [11] Wodehouse R P 1935 *Pollen grains. Their structure, identification and significance in science and medicine* (New York and London)
- [12] Progunkov V V 2011 Flower conveyor of the south of the Far East *Beekeeping* [in Russian - Pchelovodstvo] **2** 24-25

- [13] Urusov V M and Lobanov I I 2018 *Trees, shrubs and lianas of Primorsky Krai* (TIGDVORAN, Vladivostok) p 475
- [14] *Vascular plants of the Soviet Far East* ed. Kharkevich SS 1987 vol 2 (Science, Leningrad) p 446
- [15] Pulinets E K 2004 *Comparative evaluation of various terms and methods of raising of queen bees*, Phd thesis, Primorskaya State Academy of Agriculture p 142
- [16] Kodes L G and Popova I V 2010 *Specific, economic and useful features of bees of the Far East: monograph* (Ussuriisk) p 196
- [17] Pulinets A K and Grigorovich M I 2017 Wood species of the Araliceae (araliceae) - their importance in the formation of secondary honey crop in the taiga zone of the Primorsky Territory *Agrarian Vestnik of Primorye* [in Russian – Agrarniy vestnik Primorie] **1** 49-51
- [18] *Vascular plants of the Soviet Far East* ed Kharkevich S 1996 vol 8 (Science, St. Petersburg) p 370
- [19] *Red Book of Primorsky Krai: Plants* 2008 (AVK Apelsin, Vladivostok) pp 206-207
- [20] GOST 19792-2017 *Natural honey. Technical conditions* 2018 (Standartinform, Moscow)