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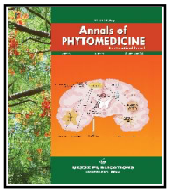

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Natural distribution of melliferous trees and shrubs in the Western Tien-Shan mountain ridge

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Abstract

The natural distribution of melliferous trees and shrubs also plays a significant role in forest areas as they serve as feeding areas for bees. The article presents the results from a study on the growth, bioecology, natural reproduction, and productivity of melliferous trees and shrubs in natural forests.

1. Introduction

For the rational use of honey plants, it is necessary to increase its composition, the distribution of biological properties, flowering periods, and the productivity of honey production. As a result of the fulfillment of these tasks, a technology will be developed for placing trees and shrubs that bloom all year round and give a large amount of honey on the lands of the forest fund. Hives tend to move to different areas throughout the year and in different seasons. Since after the end of the flowering period in one area, it is not practical to keep them in this place, so it is necessary to move the hives to another area. This creates additional costs and problems. Therefore, if you place plants in one area that continuously bloom throughout the year and give a large amount of honey, you can increase the efficiency of farms specializing in beekeeping.

The relevance of the work lies in the fact that the species composition of honey plants, the technology of their cultivation, the timing of flowering placement have not been fully studied. A comprehensive study of the honey plants of the republic makes it possible to assess their potential resources from an economic point of view and determine the ways of their use, enrichment and protection in the future.

2. Materials and Methods

According to the observations of Samsonova, in the Rostov region of the Russian Federation, the main types of melliferous plants in terms of coverage area are black locust (14,800 ha), field maple and yellow locust (8,600 ha), the most common melliferous plants are linden, wild apple, pear, willow, maple (Samsonova, 2005).

The morphological diversity of pollen brings important information on the taxonomy of plants present in past and current ecosystems. Regarding the rich biodiversity and the large number of endemic plant species on the island of Madagascar, pollen reference collections are still scarce for this part of the world. The main objective of this study was to conduct a preliminary investigation of pollen morphology of flowering plants visited by honeybees in a tropical rainforest of the south-east part of Madagascar during 2014 to 2015 (Ranomafana National Park - Fianarantsoa). Samples of 135 species belonging to 105 genera and 52 families were processed, employing the standard acetolysis method. Pollen reference slides of these melliferous plants were mounted. These pollen grains were then photographed and measured using light microscopy. The 135 collected species include 54 trees, 47 shrubs, 21 herbs, 12 lianas and one epiphyte, among which 85 taxa are endemic, 46 indigenous and four exotic. Pollen morphological characteristics of 106 species (85% endemic) are described here for the first time. Since these endemic plant taxa have co-evolved with the endemic honeybee of Madagascar, Apismellifera unicolor, the implications of the pollen grain morphology for plant-pollinator co-evolution are discussed (Rasoloarijao *et al*., 2019).

The natural flora of the Vedensky Biological Reserve (Chechen Republic) has been studied, including 1543 species of vascular plants from 545 genera and 119 families. 12 large families (Asteraceae, Poaceae, Fabaceae, Lamiaceae, Brassicaceae, Rosaceae, Apiaceae, Caryophyllaceae, Boraginaceae, Scrophulariaceae, Ranunculaceae, Rubiaceae) including 492 species, and 20 large genera (Astragalus, Rosa, Orobanche, Medicago, Carex, Trifolium, Hieracium, Vicia, Allium, Stipa, Geranium, Festuca, Veronica, Artemisia, Viola, Poa, Centaurea, Euphorbia, Galium, Orchis) uniting 166 species are

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specified. By the dominant large families, the flora belongs to the Mediterranean type, and by the set of families of the head spectrum part and the prevailing geo-elements, it is Caucasian-Palaearctic one. Among the 7 florocoenotypes represented here, the rocky-talus and shrub-fringe ones prevail with significant participation of the meadow florocoenotype. More than half of the flora (54.53%) is occupied by hemicryptophytes, and half as much as they-by terophytes (26.79%), phanerophytes (9.2%), cryptophytes (7.14%), and hamephites (2.34%) are less common. Herbaceous plants make up 88.46%, trees and shrubs-9.20%, and subshrubs and dwarf shrubs - 2.34% of the flora. The flora is rich in resource-useful species: 157 food, 288 fodder, 178 medicinal, 120 poisonous, 202 melliferous, 314 decorative, and 81 industrial plants (Taysumov *et al.,* 2021).

In the context of globalization, two major human challenges are global warming and the loss of biological and cultural diversity. Solving the latter problem can help reduce greenhouse gases, diversify production, and maintain agrobiodiversity. The objective was to propose a design of complex agroecosystems based on indigenous and scientific knowledge. In 66 agroecosystems from seven ejidos (communal lands used for agriculture), the tree species were determined in 400 square meter plots, considering three layers: high (up to 35 m), middle (up to 25 m), and low (< 17.5 m), estimating carbon sequestration using allometric equations. Three participatory workshops were carried out with 36 peasants to corroborate the species observed in the field and create lists of attributes (foliage production, cover, growth speed, and flowering and fruiting periods). With these attributes, as well as carbon sequestration capacity, melliferous and nectar potential, a proposal for an agroecosystem design was developed by Farrington, (2005); Ávila-Bello *et al.* (2023).

Accurate information about the flowering period of honey plants allows timely planning and implementation of the correct placement of bee colonies during the beekeeping season (Dzhangaliev, 2003; Antonie, 2014).

Of great importance for physiological processes are various mineral elements that come with medicinal plants and food (tea, herbal infusions, tinctures, honey, pollen, *etc*.). The content of nine mineral elements: K, Ca, Mg, Na, Fe, Mn, Cu, Zn, Cd in different parts (leaves, flowers, bark) of three honey plants was studied. From the wild flora of the Dobruja region in May and June 2019, species with the highest honey yield were collected: *Sambacus nigra*, *Hypericum perforatum* and *Tiliato mentosa*. Determination of the amount of mineral elements in the components of these medicinal plants was carried out by FAAS (atomic absorption flame spectrometry). The uptake of various metal ions by honey plants is controlled by soil properties such as pH, salinity, electrical conductivity, and organic matter content. In this regard, the average concentration of Zn in the stems of *S. snigra*, collected in the experimental plot, is 6.893 mg/kg, and in the bark of the felted linden - 101.46 mg/kg. The physiological activity of honey plants causes the breakdown of zinc and the interaction of many elements such as Fe and Mn. Analysis of Cd in honey plants showed that the concentration of Cd ranged from 0.001 mg/kg in *S. nigra* to 5.64 mg/kg in leaves of *Tiliato mentosa* (Barbes *et al*., 2020).

3. Results

The mountainous region of Central Asia is rich in forests. These forests, located on the slopes of the mountains, play an important role in conserving water resources and protecting soil from erosion. Due to the presence of plants, river water seeps into the soil, erosion and flood processes are prevented. The forest floor and humus layer under the forest floor retains most of the runoff from the soil surface. Collecting snow, the groves provide an even distribution of moisture along the slopes and water flow to irrigated lands.

Determination of honey productivity is carried out in order to establish new apiaries or expand existing ones, determine the size of apiaries, stationary or temporary sites, beekeeping places. The honey content is calculated on an area of about 1250 hectares within a radius of 2 km from the honey collection area.

In the plan of land management of the forestry, the location of the hive is determined by a circle with a radius of 2 km. Then, on the basis of the land use map, the areas where entomophilous agricultural crops, fruit and berry plantations, vegetable and fruit crops, as well as the areas occupied by forests are planted, and their honey content is taken into account. The productivity of areas occupied by honey crops is determined by multiplying the honey yield of plants from 1 hectare of planting by the entire area of the field.

Due to the fact that the trees do not give the same yield every year, 30-40% of the seeds die, and 10% of the seeds are blown away by the wind, natural recovery is always unsatisfactory. Seeds ripen at different times: May-June (beech, yellow acacia, cherry, hazel, alder, poplar, willow, bird cherry), July-August (oak, beech, pear, apple tree), September-October (black locust, Honey locust, pine, spruce, larch, fir). In general, natural regeneration in the forest area, as well as Black locust forests, is in an unsatisfactory state.

When studying a naturally distributed field, it became known that the trees of the Black locust on the southeastern exposure of the Tien-Shan ridge, it was noted that the height of the trees is from 6 m to 21 m, the diameter of the trunk is from 5 cm to 22 cm, and their age ranges from 8 up to 22 years old. Most of the studied trees have reached the flowering stage, it is established that they are already the main food base for beekeeping, and the area of natural forest is currently continuing to expand.

Among the tree species growing in natural conditions along with black locust on the experimental plot, walnut 1 pc, wild cherry togolcha 20 pcs, dog rose 4 pcs, blackberry 1 pc, hawthorn 15 pcs, plane tree 4 pcs, pashtun juniper 1 pc , mahaleb cherry 3 pcs and cherry in the amount of 15-20 pcs. Thus, for the design of reforestation measures in the southeastern part of the exposition, additional reforestation measures for other types of forests are not required, but it is necessary to strengthen forestry measures for reforestation and the natural distribution of black locust forests (Figures 1, 2).

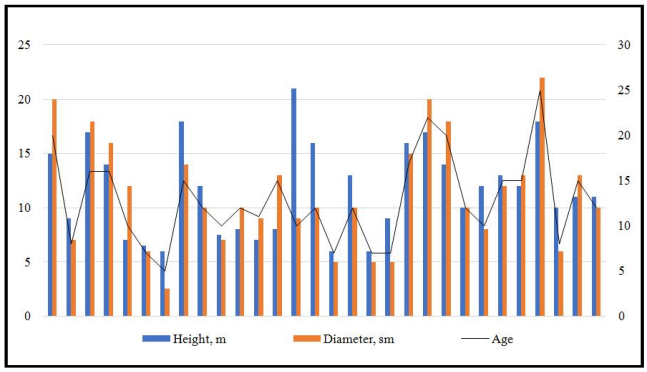

Figure 1: Indicators of trees in the black locust natural forest. (980 m above sea level, N 41.72319034, E 70.07135765)

The dispersal of seeds and their fall to the ground occurs when the seeds ripen on some tree species. The seeds of linden species, Black locust, Japanese Sophora remain on the branches until spring or slowly fall in winter. Seeds are spread by wind, water, birds, forest animals.

Table 1: Large-leaved linden (altitude 1080 m above sea level, N 41.72319034, E 70.07135765. 112 naturally grown trees, area 20 x 30 m. large trees)

Number of trees	Hight, m	Diameter, sm	Age of tree
1.	23	33	30
2.	23	30	28
3.	23	30	28
4.	15	24	25
5.	20	40	35
6.	23	24	23
7.	18	23	20
8.	25	48	38

Lindens, planted in the Burchmulla State Forestry in the 1970s for the purpose of mother plantation, have now passed into the process of natural reproduction. There are favorable conditions in the forest for the formation of pure linden forests, but unfortunately, there are also disadvantages. Distribution in linden forests on the outcrop of the forest slope is a favorable condition for them, since in addition to atmospheric moisture, there is moisture inflow from high relief zones and accumulation due to slow spring snowmelt. At the same time, the fertility of undergrowth soils is high in exposures of forest slopes.

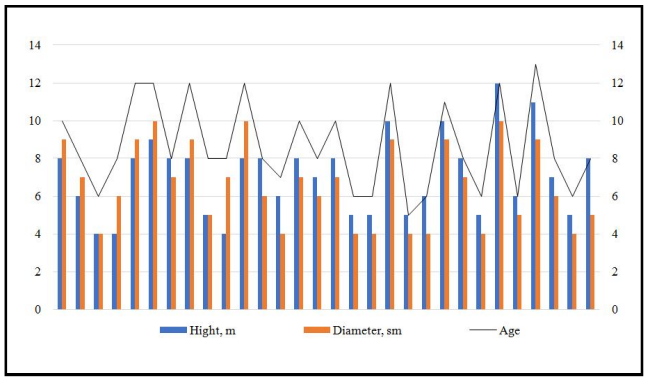

Figure 2: Indicators of trees in a large-leaved linden forest. (field size 20x30 m, 1080 m above sea level, N 41.7231 9034,E 70.07135765, 112 grains naturally grown).

Table 2: A plantation consisting of tree species belonging to the Rosaceae family. The main types of trees: Turkestan hawthorn, apricot, mountain ash

Number of trees	Turkestan hawthorn		Apricot		Mountain ash	
	height, m	diameter, cm	height, m	diameter, cm	height, m	diameter, cm
1.	7	25	8	38	4	12
2.	5	20	7	30	5	14
3.	6	22	8	28	4	12
4.	7	20	10	35	3	10
5.	6	18	9	32	3	9
6.	5	18	6	28	4	12
7.	6	14	8	30	5	14
8.	7	20	8	31	5	12
9.	8	21	9	30	4	10
10.	6	20	10	35	4	12

4. Discussion

After the completion of the observation, the indicators obtained for each type of honey plants are summed up, the result is divided by the number of trial plots and thus it is found what part (in per cent) of the total area of the array they occupy. From the ratio of trees in the plant, the area corresponding to the proportion of melliferous trees corresponding to the total area can be calculated.

The productivity of the forest area is determined by counting honey and non-melliferous trees at the same distance from 10 m^2 to 20 points. Plots are surveyed diagonally, taking into account all trees growing in a two-meter line (approximately 1 m to the right and 1 m to the left).

After the calculation is completed, the coefficient is calculated as a percentage of different tree species. Suppose 1000 trees, including 200 lindens and 50 maples, are counted with a special count of the main green plants of the forest. The share of linden in the forest is 20%, maple - 5%. Thus, the total forest area is 200 hectares, lindens occupy 40 hectares, maples-10 hectares.

Mountain forests of Uzbekistan according to their characteristics are divided into 2: The lower mountain includes land at an altitude of 1200-2000 meters above sea level. This place adjoins a high hill and is characterized by a large number of ephemerides, which remain green for a long time. Ephemera are rare and grow under shrubs, shrubs and trees. Trees are very rare because they have suffered a lot from human error. Highlands include places from 2000 meters above sea level to 2700-3200 meters. The main part of the vegetation growing here is juniper and wild fruit trees and shrubs. The relief of this place is uneven. These lands consist of steep slopes covered with large stones, large streams and ravines.

The forests of Uzbekistan can be grouped into the following 4 types according to the main types of trees that make up the forest: juniper, walnut, pistachio and mountain tugai forests. Wooded mountain forests consist mainly of coniferous and mostly juniper forests. The range of junipers in Central Asia is about 633,000 ha, including 190,000 ha in Uzbekistan. Pistachio forests are inferior in area after juniper forests (86.6 thousand ha). The area of almond groves is 9.9 thousand hectares, walnuts and apple trees grow less. Hawthorn, maple, mountain ash and other tree species make up 0.1-0.6% of mountain forests. Shrub plants occupy a relatively small area in mountain forests.

Along with juniper, in the mountain ranges of the Western Tien-Shan, there are: Tien-Shan birch (*Betula tianschanica* Rupr.) and Turkestan birch (*Betula turkestanica* Roth.), willow (*Salix*), Caucasian frame (*Celtis saucasica*), mountain ash (*Sorbus turkestanica*) Semenov and Turkestan maples (*Acer turkestanica*, *A. Semonovii*) and other species.

Deciduous mountain forests are divided into mesophytic and xerophytic groups according to their composition. The first place among them is occupied by walnut forests, as well as apple, maple, cherry, hawthorn, honeysuckle and other species.

Xerophytic forests are formed from pistachios, almonds, jujube, dog rose, tamarix, sumac and other species. The forest is the main element of the geographical landscape, consisting of trees, shrubs, grasses, representatives of the animal world and microorganisms, closely related to each other and influencing each other and the external environment. Nectar forests contain trees, shrubs, grasses, and various animals. They form a closely related biogeocenosis.

The morphology of the forest is different. These include pure forests, mixed forests, forests of the same or different ages. Pure forests are forests consisting of only one type of tree or shrub. Such forests are rare in nature and can only be created artificially. Since artificial forests are man-made, such forests can also be forests of the same age. A mixed forest is a forest consisting of different types of trees or shrubs. Such forests are often found in naturally growing forests. At the same time, these forest types are forests of different ages.

Observations were made in natural forests around the experimental site. Fullness (fullness)-a tree trunk of 1 ha is determined by the cross-sectional area (1.3 meters high). The completeness ranges from 0.1 to 1 and increases upwards. Deciduous mountain forests are divided into mesophytic and xerophytic groups according to their composition. The first place among them is occupied by walnut forests, as well as apple, maple, cherry, hawthorn, honeysuckle and other species. Xerophytic forests are formed from pistachios, almonds, jujube, dog rose, tamarix, sumac and other species.

A characteristic feature of the deciduous mountain forests of Central Asia is that they contain many fruit trees and shrubs. Some species (walnuts, wild apple trees, cherries, *etc*.) are distinguished by an abundance of different varieties and constitute a rich gene pool of fruit species.

Tree growth is a process that increases the size of a tree as cells multiply and increase in number. According to the nature of growth, trees are divided into fast-growing and slow-growing. The criterion for assessing the growth rate of trees is the growth in height for the previous growing season. The appearance of a new young generation of trees in the forest is called the process of natural renewal. In forestry practice, natural and artificial regeneration is used.

With the natural regeneration of the forest from seeds, the young generation is reproduced from seeds. This process is divided into 4 periods:

- fruiting (seed-bearing) of trees;
- seed germination and emergence of seedlings;
- life and development of seedlings;
- life and development of a young tree.

The age at which trees reach the normal age of constant fruiting is called the age of regeneration or the age of maturity. This age is different for different trees: linden, Black locust, Japanese sophora-15-20 years, ligustrum-5-8 years, and for goji-3-5 years. The better the climate and soil conditions, the more often seed years repeat. Class II trees according to Kraft's classification produce the main seed. Seeds at the top of the tree have good germination. Reproduction from natural seeds in the forest occurs as a result of the spread of seeds of trees growing in this area.

5. Conclusion

There are other species that make up the main forest around the linden, most of which are melliferous trees and shrubs. The growth of linden in a mixed state with these species affects the quality of honey and its unique taste.

Most of the forests here consist mainly of two forest layers. The first tiers consist of walnut, Crimean pine, large-leaved linden, wild pear and apple. The completeness of the first layer is 0.7-0.8. The species composition of the second layer is more diverse than that of the first layer. Usually, it consists of 3-5 species of trees, among which red hawthorn, mahaleb cherry, wild cherry predominate. The completeness of the second layer: equal to 0.3-0.8. In addition, several types of shrubs were noted, among which dog rose, irgai and barberry are widespread. Along with large-leaved linden, tree species grow in nature in the study area: walnut, wild cherry dog rose, black willow, hawthorn, blackberry, juniper, mahaleb cherry and prunus.

Wild fruit trees occupy a special place among the broad-leaved forests of the lower foothills, represented mainly by apple, hawthorn, apricot and cherry forests. Such forests occupy hundreds of hectares in the Tien-Shan mountains. Until today, their range is extensive, and the largest massifs are located in the foothills. In some places they occupy more than 15% of the forest area. Occurs in the southern and northern expositions of the Burchmulla State Forestry. In the southeastern and southwestern parts of the country, this figure is about 10%. The trees here are over 50 years old, but natural renewal is satisfactory. In mountainous and foothill areas, nectar excretion of species depends on the phase of flowering of trees and shrubs related to natural conditions.

A variety of trees and shrubs in mixed forests is a good condition for the intensive development of bees in spring. In these groves, the presence of species of black locust and linden, which bloom in spring and have high nectar properties, gives a higher effect. To further improve the natural reproduction of these trees in the region of the Western Tien-Shan, some anthropogenic factors (especially livestock) should be limited. It is also useful to plant seedlings of trees in sparse groves and open spaces.

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