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PLANTS AS POLLEN SOURCES FOR BEEKEEPING ON THE ARAZBOI PLAIN OF THE NAKHCHIVAN AUTONOMOUS REPUBLIC

©***Huseynova A.***, *ORCID: 0000-0003-0943-5214, Nakhchivan State University, Nakhchivan, Azerbaijan, azizahuseynova@ndu.edu.az*
©***Mammadova Sh.***, *ORCİD: 0000-0002-1399-8813, Institute of Genetic Resources, Baku, Azerbaijan, shamsiye@bk.ru*

РАСТЕНИЯ-ИСТОЧНИКИ ПЫЛЬЦЫ ДЛЯ ПЧЕЛОВОДСТВА НА АРАЗБОЙСКОЙ РАВНИНЕ НАХЧЫВАНСКОЙ АВТОНОМНОЙ РЕСПУБЛИКИ

©***Гусейнова А.***, *Нахчыванский государственный университет, г. Нахчыван, Азербайджан, azizahuseynova@ndu.edu.az*
©***Мамедова Ш.***, *ORCID: 0000-0002-1399-8813, Институт генетических ресурсов, г. Баку, Азербайджан, shamsiye@bk.ru*

Abstract. In this study, pollen- and nectar-source plants in the lowlands along the Araz River and adjacent areas of the Nakhchivan Autonomous Republic were investigated. These areas are located at approximately 600–1100 m above sea level, where temperatures begin to rise early and most plants flower in March, April, and May. This period is particularly important for the nutrition of bee colonies during the early larval stage after winter. Based on field observations, bees were found to frequently visit plants belonging to 13 families and 43 genera. Among the plant families visited by bees, Lamiaceae (12 genera), Rosaceae Adans. (8 genera), and Fabaceae (8 genera) were the most represented. The earliest-flowering plants belonged to the families Salicaceae, Elaeagnaceae, Rosaceae, and Liliaceae. The plants identified as pollen sources included willow, wild onion, poplar, oak, maize, chickweed, wormwood, sunflower, dandelion, and Ranunculus. Adequate nutrition of bee colonies in early spring is important for maintaining their health throughout the year and ensuring high productivity. Therefore, the lowlands along the Araz River are of great importance for beekeeping in early spring, and increasing the number of pollen- and nectar-producing plants in this area is recommended.

Аннотация. Были исследованы растения-источники пыльцы и нектара в низинах вдоль реки Араз и прилегающих районах Нахчыванской Автономной Республики. Эти районы расположены на высоте примерно 600–1100 м над уровнем моря, где температура начинает повышаться рано, и большинство растений цветут в марте, апреле и мае. Этот период особенно важен для питания пчелиных семей на ранней личиночной стадии после зимы. На основе полевых наблюдений было установлено, что пчелы часто посещают растения, принадлежащие к 13 семействам и 43 родам. Среди семейств растений, посещаемых пчелами, наиболее представлены Lamiaceae (12 родов), Rosaceae Adans. (8 родов) и Fabaceae (8 родов). Самые раннецветущие растения принадлежат к семействам Salicaceae, Elaeagnaceae, Rosaceae и Liliaceae. В качестве источников пыльцы были определены ива, дикий лук, тополь, дуб, кукуруза, звездчатка, полынь, подсолнечник, одуванчик и лютик. Адекватное питание пчелиных семей ранней весной важно для поддержания их здоровья в течение всего года и обеспечения высокой продуктивности. Поэтому низменность вдоль реки Араз имеет большое значение для пчеловодства ранней весной, и рекомендуется увеличить количество растений, производящих пыльцу и нектар, в этом районе.

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Keywords: lowland along the Araz River, honeybee, pollen, nectar.

Ключевые слова: низменность вдоль реки Араз, медоносная пчела, пыльца, нектар.

Beekeeping is one of the important branches of agriculture and is of particular importance from both economic and ecological perspectives. This sector provides valuable products such as honey, bee pollen, royal jelly, propolis, and bee venom. Although bee products are derived from both animal and plant sources, plants play a major role in their formation. Bees mainly use plant nectar, pollen, resins, and other plant-derived substances to produce honey and other bee products [18].

Plants are the main source of secondary metabolites that contribute to the nutritional and pharmacological properties of bee products [3, 13, 14].

In this regard, the study of natural and cultivated honey-producing plants that constitute the forage base for beekeeping, as well as the assessment of their floristic composition and distribution characteristics, is of great scientific and practical importance. The territory of the Nakhchivan Autonomous Republic is divided into semi-desert, foothill, mid-mountain, subalpine, and alpine zones, which differ in altitude from lowland along the Araz River plain to the mountainous areas. The Nakhchivan Autonomous Republic has a rich flora, with more than 3,000 plant species distributed across different altitudinal zones. The lowland along the Araz River plain and semi-desert zone is a relatively narrow area extending along the Araz River at an altitude of approximately 600–900 m above sea level. The vegetation of this zone is mainly composed of xerophytic plants, and the area plays an important role in providing forage for honey bees during early spring. The lower and middle mountain zones are located at altitudes ranging from approximately 800 to 2,200 m above sea level. These areas are characterized by diverse herbaceous plants and shrubs. The relatively mild climate provides a longer flowering period, making these zones important areas for beekeeping. They also serve as important pollen sources for honey bees during the summer season. The subalpine meadow zones are mainly used as summer pastures and occur at altitudes of approximately 2,200–2,800 m above sea level. These areas are dominated by meadow vegetation and provide important forage resources for honey bees during the summer months [5, 6, 18].

Due to climatic differences associated with altitude, the flowering periods of plants vary between zones. This is one of the factors that directly affects the development of beekeeping. Bee colonies from mountainous and foothill areas are moved to the lowland zone in early spring (February–March). As flowering progresses in different areas, the colonies are gradually moved to the foothill and mountainous zones. This seasonal movement plays an important role in the nutrition and normal development of bee colonies [20].

Thus, during spring, bees can effectively utilize plants that flower successively in different zones. This helps ensure a continuous supply of food for bee colonies. In the Nakhchivan Autonomous Republic, the lowland along the Araz River is the most important area for bee nutrition during early spring. The aim of this study is to identify plant species important for beekeeping in the lowland along the Araz River and adjacent areas of the Nakhchivan Autonomous Republic, determine their flowering periods, assess their importance as sources of nectar and pollen, study the role of these plants in the formation of the seasonal food base of bee colonies, and analyze their role in bee colony development through the study of the chemical composition of pollen in future research [9-12].

Material, Method

The study focused on pollen- and nectar-source plants distributed around settlements located in the lowland along the Araz River and adjacent areas of the Nakhchivan Autonomous Republic, at approximately 600–1100 m above sea level. During the study, observations were made of widespread

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cultivated, agricultural and wild plants in the villages of Dervishlar, Kivrag, Tumbul, Karachug, Nehram and Kamaldin, as well as in the adjacent areas.

Records were made of their flowering periods and their importance to honey bees. Plant genera were identified based on Talıbov (2021), while the selection of plants by honey bees was recorded based on field observations and the data reported by Quliyev (2014) [20-22].

The lowland zone along the Araz River in the Nakhchivan Autonomous Republic is characterized by a dry continental climate. The area is predominantly characterized by a moderately warm semi-desert and dry steppe climate with dry summers. The average annual temperature is 10–14°C, while annual precipitation is up to 300 mm [8].

In these areas, temperatures begin to rise early, and the flowering period of most plants occurs in March, April, and May. These conditions allow honey bees to make extensive use of the pollen and nectar of plants growing along the Araz River during early spring [15].

Results and Discussion

The altitude difference between the zones of the Nakhchivan Autonomous Republic reaches 1,500–2,000 m [6, 22].

This difference in altitude causes variations in the vegetation and flowering periods of plants. In the lowland along the Araz River, temperatures begin to rise earlier, and nectar- and pollen-source plants start flowering from late February to March (Table 1).

Table 1

NECTAR-POLLEN PLANTS IN THE PLAIN ALONG THE ARAZ RIVER AND NEARBY AREAS

Family	*Genus*	*Flowering period*	*Importance for honey bees*	*Regions where it is distributed*
Salicacceac Mirb.	Salix L.	March	Early pollen source	Found along the Araz River
	Populus L.	March	Early pollen source	Found along the Araz River
Elaeagnaceae Adans.	Elaeagnus L.	April-May	Provides pollen and aromatic nectar	Widely distributed along rivers and in residential areas
Fagaceae Dumor.	Quercus L.	April-May	Pollen-producing plant	İn gardens and dry slopes
Betulaceae S.F.Gray	Betua L.	May	Pollen and necta producing plant	İn gardens and dry slopes
Rosaceae Adans.	Amygdalus L.	March-April	A valuable early spring pollen source	Cultivated in gardens and dry slopes
	Malus Mill.	March-April	An important pollen source	Cultivated in orchards
	Persica Mill.	March-April	Provides pollen and nectar	Cultivated in orchards
	Fragaria L.	April-May	Provides pollen and nectar	Cultivated in agricultural fields
	Pyrus L.	March-April	Provides pollen and nectar	Cultivated in orchards
	Gerasus Mill.	April-May	Provides pollen and nectar	Cultivated in orchards
	Armeniaca Mill.	March-April	Provides abundant pollen and nectar in early spring	Cultivated in orchards
	Prunus L.	March-April	Provides abundant pollen and nectar in early spring	Found in gardens and in the wild
Fabaceae L.	*Cercis* L.	March-April	Provides pollen and nectar in early spring	Distributed in meadows

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Family	*Genus*	*Flowering period*	*Importance for honey bees*	*Regions where it is distributed*
	Cicer L.	April-May	Provides a moderate amount of pollen	Widely cultivated in agricultural fields
	Lathyrus L. (Orobus L.)	April-June	A good source of pollen and nectar	Found in gardens and in the wild
	Lotus L.	May- July	A good source of pollen and nectar	Along roadsides
	Melilotus Hill	May – August	One of the most valuable honey plants	Distributed in meadows
	Onobrychis Hill.	May–June	A good source of pollen and nectar	Found in gardens and in the wild
	Medicago L.	May–September	A good source of pollen and nectar	Widely cultivated as a forage crop
	Astragalus L.	May–June	Source of pollen and nectar	Distributed in semi-desert and foothill areas
	Robinia L.	May	A good source of pollen and nectar	Cultivated in parks, roadside plantings, and residential areas
	Trifolium L.	May- July	One of the most valuable nectar and pollen plants	Distributed in fields and along roadsides
Poaceae Barnhart, nom. cons.	*Zea* L.	June-July	A good source of pollen	Widely cultivated in agricultural fields
Brassiaceae Burnett	*Barbarea* R.Br.	April-May	A good source of pollen and a moderate source of nectar	Found along rivers, in irrigated areas, and in moist habitats
	Brassica L.	April-May	A good source of pollen and nectar	Cultivated in agricultural fields, with some wild species distributed in open areas
	Capsella Medik.	April-May	Mainly a pollen source	Widely distributed in fallow and cultivated lands
Lamiaceae Martinov	*Ajuqa* L.	April – June	One of the most valuable nectar and pollen plants	In meadows, shrublands, and along field margins
	Nepeta L.	May- July	A good source of pollen and nectar	On rocky slopes, in dry pastures, and in the lowlands along the Araz River
	Lamium L.	March – May	Early spring source of nectar and pollen	In moist areas, along the edges of gardens and cultivated fields
	Leonurus L.	June–August	Rich in nectar	In vacant areas and along roadsides
	Mentha L.	June–September	A good source of pollen and nectar	Along rivers and irrigation channels, and in irrigated areas
	Origanum L.	June–August	One of the most valuable honey plants	On dry slopes and in shrublands
	Phlomis spp.	May- July	Rich in pollen	Distributed in some dry areas of the lowland along the Araz River
	Prunella L.	May- July	A good source of pollen and nectar	On dry slopes and in the hills along the Araz River

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Family	*Genus*	*Flowering period*	*Importance for honey bees*	*Regions where it is distributed*
	Salvia L.	May- July	A good source of nectar	Widely distributed on rocky and dry slopes
	Stachys L.	May – August	A good source of pollen and nectar	In dry meadows and shrublands
	Teucrium L.	June– August	A good source of nectar	In rocky and arid areas
	Thymus L.	June– August	Provides aromatic, high-quality pollen and nectar	Found on dry slopes and in lowland areas
Asteraceae Bercht. & J.Presl	*Artemisia L.*	August– September	Mainly a pollen source	One of the dominant plants in the semi-deserts along the Araz River
	Helianthus L.	July– August	A rich pollen source	Cultivated in agricultural fields
	Taraxacum Wigg.	April-May	Mainly a pollen source	In meadows and along roadsides
Ranunculaceae Adans.	*Ranunculus* L.	April-May	A rich pollen source	In meadows, shrublands, and along field margins
Liliaceae Juss.	*Gagea* Salisb	March	Early pollen source	In meadows and along roadsides

This is particularly important for the nutrition of bee colonies during the early larval stage after winter. In this zone, ephemeral plants and fruit trees are the first to start flowering, followed by meadow and cultivated plants. Based on our observations, the flowering periods of plants belonging to different families in the lowland along the Araz River complement each other. In early spring, representatives of the families Salicaceae, Elaeagnaceae, Rosaceae, and Liliaceae meet the initial nectar and pollen requirements of honey bees. Starting from May, the mass flowering of plants belonging to the families Fabaceae, Brassicaceae, Lamiaceae, and Asteraceae ensures a continuous supply of nectar and pollen. From late spring onward, the transfer of bee colonies to mountainous areas reduces the intensity of their use of the forage resources of the lowland along the Araz River (Table 2).

Early-spring flowering plants play an important role in the post-winter development of bee colonies. During this period, due to the limited availability of natural nectar and pollen sources, early-flowering plants provide an important food base for meeting the protein, energy, and biologically active compound requirements of bee colonies. Studies have shown that the biological value of bee pollen, bee bread, and honey is closely associated with the plant-derived secondary metabolites they contain, with plant pollen being a major source of these compounds. Alkaloids, polyphenols, terpenoids, and other secondary metabolites consumed by bees through their diet play an important role in their nutrition, maintenance of physiological condition, enhancement of immune defense, and increased resistance to diseases [2].

One of the plant genera of particular importance for beekeeping in the lowland along the Araz River in early spring is *Salix* L. Flowering of these plants is mainly observed from late February to April. Since willow provides both nectar and protein-rich pollen in early spring, it is considered one of the main plants supporting the post-winter development of bee colonies. Literature data also indicate that willow pollen has a positive effect on the development of worker bees [16].

Another valuable group of early-spring flowering plants is the genus *Elaeagnus* L. In the lowland along the Araz River, species of this genus generally flower from late March to early April and are intensively visited by honey bees. The abundant production of nectar and pollen by their flowers makes these plants an important food source for bee colonies during early spring. Studies on

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the chemical composition of pollen from *Elaeagnus angustifolia* L., which is distributed in the Nakhchivan Autonomous Republic, have shown that it is rich in polyphenols and flavonoids, with ellagic and gallic acids being particularly abundant [11].

Table 2

DYNAMICS OF PLANT FLOWERING ON THE ARAZ FLOWERING PLANT

Family	*Early spring (March-April)*	*Mid-spring (April-May)*	*Late spring/early summer (May-June)*	*Summer*
Salicacceac Mirb.	*			
Elaeagnaceae Adans.	*			
Fagaceae Dumor.		*		
Betulaceae S.F.Gray		*		
Rosaceae Adans.	*			
Fabaceae Lindl.		*	*	
Brassiaceae Burnett.		*		
Lamiaceae Lindl.			*	
Asteraceae Dumort		*		*
Ranunculaceae Adans.		*		
Liliaceae Juss.	*			

These biologically active compounds may increase the nutritional and antioxidant value of pollen and may positively contribute to maintaining the physiological condition and normal development of bee colonies during early spring. Fruit trees belonging to the family Rosaceae Adans. that flower in early spring in the lowland along the Araz River are also among the main pollen sources for bee colonies. Almond (*Amygdalus* L.), apricot (*Prunus armeniaca* L.), cherry plum (*Prunus cerasifera* Ehrh.), apple (*Malus domestica* Borkh.), pear (*Pyrus communis* L.), peach (*Persica* Mill.), plum (*Prunus* L.), and sour cherry (*Cerasus vulgaris* Mill.) flower abundantly from late March to April and play an important role in meeting the nutritional requirements of bee colonies. Literature data also indicate that the early-spring flowering of fruit trees belonging to the family Rosaceae in the Nakhchivan Autonomous Republic is important for the development of bee colonies and the formation of pollen reserves during the spring season. Our studies on the biochemical composition of pollen from plants belonging to the family Rosaceae are ongoing [9, 12, 21].

Among the pollen sources available during the summer season, *Helianthus annuus* L. (sunflower) is of particular importance. This plant is characterized by high pollen production and is intensively visited by honey bees. In a study by Ferguson et al. (2024), the fatty acid composition of pollen from different sunflower lines was compared, and it was found that the chemical characteristics of pollen may influence the food preferences of pollinators. Another study also found that the protein content of sunflower pollen varied considerably, ranging from 7.32 to 19.40 g/100 g [4, 19].

Species belonging to the genus *Ranunculus* L., which flower in April–May in the lowland along the Araz River, are used by honey bees as a pollen source despite containing some toxic compounds [1, 17].

During early spring, these plants contribute to enriching the food resources available to bee colonies. It has been determined that the pollen of *Ranunculus arvensis* L. has a high phenolic and flavonoid content and possesses antioxidant properties [10].

Artemisia fragrans Willd. (wormwood), which is widely distributed in the semi-desert landscapes of the lowland along the Araz River, is one of the important pollen sources for honey bees from late summer to early autumn. The flowering phenology and nectar productivity per hectare of

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this species were evaluated, and its important role in the beekeeping potential of the region was demonstrated [20].

The flowering of plants at different times allows honey bees to have access to nectar and pollen over an extended period. These plants are particularly important for the nutrition and development of bee colonies in early spring. Therefore, studying the species composition, distribution, and flowering periods of plants important for beekeeping in the lowland along the Araz River is essential for assessing the forage resources available for beekeeping. At the same time, studying the chemical composition of plant pollen, particularly proteins, phenolic compounds, flavonoids, and other biologically active substances, allows a more comprehensive assessment of the role of these components in the nutrition, health, and productivity of bee colonies. The results of such studies can provide a scientific basis for identifying pollen sources with high nutritional value, enriching the forage resources of beekeeping farms, and increasing the production of high-quality bee products.

Conclusion

The observations conducted in this study show that the lowland along the Araz River in the Nakhchivan Autonomous Republic is one of the areas providing important food resources for honey bees in early spring. The study identified 43 plant genera belonging to 13 families that were frequently visited by honey bees. Among the visited plants, the families Lamiaceae (12 genera), Rosaceae Adans. (8 genera), and Fabaceae (8 genera) were the most represented. In early spring, plants belonging to the families Salicaceae, Elaeagnaceae, Rosaceae, and Liliaceae were observed to begin flowering. The results of the study demonstrate that the lowland along the Araz River has rich plant resources of importance for beekeeping. Studying the main pollen- and nectar-source plants distributed in this area is important for improving the nutrition of bee colonies and increasing the production of bee products. Our studies on the chemical composition of the main pollen-source plants distributed in the lowland along the Araz River and their effects on the development of bee colonies are ongoing.

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