Advanced Studies in Biology, Vol. 15, 2023, no. 1, 215 - 221
HIKARI Ltd, www.m-hikari.com
https://doi.org/10.12988/asb.2023.91815

Morphometric Indicators of Pollen of Some Trees and Shrubs Distributed in the Northeastern Part of the Greater Caucasus (Azerbaijan) in ex situ Conditions

K. A. Memmedova [1] and A. A. Arabzade [2]

[1] Azerbaijan State Pedagogical University, Baku, Azerbaijan
[2] Central Botanical Garden, Baku, Azerbaijan

This article is distributed under the Creative Commons by-nc-nd Attribution License.
Copyright © 2023 Hikari Ltd.

Abstract

In the conducted research, in ex situ condition were studied the main characteristics of the pollen of trees and shrubs distributed in the northeastern part of the Greater Caucasus (Azerbaijan). During the research were analyzed the morphology and morphometric measurements of pollen of 18 species included to the 13 genera and 10 families: the length of the polar and equatorial diameter, the length of the furrow, the width of the mesocolpium, the diameter of the apocolnium. The studied species were distinguished by the fact that the pollen grains are spherical, oval, ellipsoidal, triangular-spherical, 1-3-4 furrowed The pollen surface was smooth in most species, but bumpy only in Lonicera xylosteum. According to the morphometric size of pollen grains, the species are small (polar size 6.7-6.9 mkm, equatorial size 6.6-7.9), large (polar size 43.9-72.9 mkm, equatorial size 42.2-71 ,97 mkm) and divided into 3 groups with medium size. Among the studied species, the smallest pollen grains were observed in Cotoneaster melanocarpus (Rosaceae), and the largest pollen grains were observed in Lonicera caprifolium (Caprifoliaceae). The fact that the pollen of each species has a different sculpture, the difference in its morphometric dimensions, the taxonomic composition of the species was related to its individual biological characteristics. The viability of the pollen of the studied species was also determined.Pollen viability in the studied species varied between 51-93%.This is an indicator of their pollination and fertilization ability, as well as their high productivity.

Keywords: Pollen grains, polar, equatorial, mesocolpium, apocolpium, fertility

Introductıon

Pollens plays an important role in the formation of sowing qualities and hereditary characteristics of tree and shrub plants. From the last century to the present, the main characteristics of plant pollen have been reflected in the scientific works of many researchers around the world[1, 5, 7-8, 10-11, 14, 16].

In the literature, information about the pollen of representatives belonging to the families *Caprifoliaceae (Lonicera L.)* and *Fagaceae (Quercus L.)* is more common. By many researchers, the morphology of the pollen of the species belonging to the *Lonicera L*. genus (*Caprifoliaceae*) were studied using a light microscope, and given their description, pictures. The research conducted on allowed to determine that this genus is homogeneous according to its polynomorphology[4, 6]. When studying the pollen of East-Asian representatives of *Quercus L.* genus (*Fagaceae*), the sculptural elements of the sporoderm were described, systematized and the main types of sculpturing were determined [9]. When studying the pollen grains of species belonging to the genus of *Salix L*. cinsinə *(Salicaceae)* were revealedtheir morphological diversity and the specificity of the quantitative and qualitative indicators of each species , and determined that the signs of pollen grains were constant for the samples distributed in different parts of the area [13].

The main characteristics of the pollen of tree and shrub plants that spread naturally in the north-eastern part of the Greater Caucasus (Azerbaijan) in ex situ (Absheron Peninsula) conditions have not been sufficiently studied. Taking this into account, has been studied the morphology and morphometric measurements of the pollen grains of the studied species in ex situ (Absheron) conditions.

Material and Methods

As research material were used 18 species*(Acer campestre L., Carpinus caucasica Grossh., C.orientalis Mill., Cornus mas L., Cotoneaster melanocarpus Fisch. et Blytt, C.multiflorus Bunge, Fagus orientalis Lipsky, Lonicera caprifolium L., L.xylosteum L., Pterocarya pterocarpa (Michx) Kunth ex İ.Ilyinsk, Pyracantha coccinea (L.) M.Roem., Salix caprea L., Sorbus torminalis (L.) Grantz, Tamarix ramosissima Ledeb, Tilia begonifolia Stev., T.cordata Mill., Viburnum lantana, V.opulus L.)* belonging to the 13 genera and 10 families. The research was carried out in ex situ conditions.

Morphological and morphometric characteristics of pollen were studied to the method of A.N. Burmistrav [2], I.N. Golubinski [3], L.T. Pausheva [12] and N.S. Samigulinanin [15]. Studies were performed using a Humo Scope microscope, and photographs were taken with an AM 7023 Dino-Eye microscope camera.

Results and Their Discussion

In the conducted research were determined the morphology and morpho-

metric measurements of pollen grains of tree and shrub plants studied in Absheron conditions. When the preparations were examined under a microscope, it was determined that fertile pollen is stained pink with acetocarmine. Sterile pollens are not painted, they remain yellowish in color. The studied species differed according to the forms of the pollen grains being spherical, oval, wide elliptical, triangular-spherical, 1-3-4 furrowed. The color of the pollen is light yellow, and it is covered with an exine layer. Due to this layer, pollen maintains its durability and viability against adverse environmental conditions. In most species, the surface of the pollen is smooth, but in some species it is bumpy and uneven (*Lonicera xylosteum*). Polar, equatorial diameter and furrow length of pollen grains of each species, mesocolpium width, apocolpium diameter, pollen viability were studied and obtained results were recorded (table 1, Figure 1).

Based on the obtained results, it was determined that the size of the pollen is varies in different species. Thus, is varied between: the polar size 6.7-72.9 mkm, the equatorial size 6.60-71.97 mkm, the length of the furrow 6.20-52.9 mkm, the width of the mesocolpium 4.10-35.9, the diameter of the apocolpium is 2.10-48.2 mkm

Pollen grains of the studied species were divided into 3 groups, small, medium and large according to their morphometric size. The species *Cotoneaster melanocarpus* belonging to the genus *Cotoneaster (Rosaceae*) is distinguished by the very small size of the pollen grains. At the same time, the length of the pollen furrow (6.20-6.24 mkm), the width of the mesocolpium (4.10-5.60 mkm), and the diameter of the apocolpium (2.10-4.30 mkm) were smaller in the species Cotoneaster melancarpus.

Table 1. Morphometric indicators of species in ex situ conditions (mkm) and vitality

№	Species	Polar size	Equatorial size	The length of the furrow	Width of mesocolpium	Apocolpi-um diameter	Pollen fertility, %
1.	*Acer campestre*	34,5-41,9	29,1-43,4	27,4-34,5	21,8-22,9	10,7-14,6	90
2.	*Carpinus caucasica*	30,4-35,5	28,7-34,7	23,1-27,2	16,1-18,97	8,30-11,1	86
3.	*Carpinus orientalis*	30,99-33,1	30,8-33,99	22,9-27,2	14,5-19,7	7,70-14,4	82
4.	*Cornus mas*	19,5-34,6	18,96-30,2	16,9-27,4	10,88-20,3	7,88-13,3	80
5.	*Cotoneaster melanocarpus*	6,70-6,9	6,60-7,90	6,20-6,24	4,10-5,60	2,10-4,30	53
6.	*C.multiflorus*	19,4-28,5	20,5-28,9	18,2-24,2	12,95-15,2	6,40-7,50	71
7.	*Fagus orientalis*	34,4-45,1	37,6-44,8	27,8-34,5	18,2-25,1	9,60-15,3	82
8.	*Lonicera caprifolium*	43,9-72,9	42,2-71,97	29,1-52,9	22,9-35,9	25,9-48,2	61
9.	*L.xylosteum*	47,7-56,3	46,7-50,5	41,7-46,98	29,2-34,9	25,5-29,4	91
10.	*Pterocarya pterocarpa*	27,97-32,4	26,1-27,6	21,4-24,8	16,2-17,3	5,80-7,70	57
11.	*Pyracantha coccinea*	17,3-21,6	17,5-20,7	16,6-19,2	11,1-12,3	5,80-7,60	72
12.	*Salix caprea*	15,6-16,3	15,3-16,7	12,0-14,8	8,50-10,1	4,20-6,60	93
13.	*Sorbus torminalis*	22,9-34,4	22,5-37,0	18,6-27,4	12,8-15,95	5,10-8,60	65
14.	*Tamarix ramosissima*	13,5-13,8	11,2-13,5	9,90-11,8	5,90-7,80	5,0-6,90	54
15.	*Tilia begonifolia*	31,7-35,4	31,8-33,6	23,7-31,6	15,3-18,4	13,6-15,8	81
16.	*Tilia cordata*	30,3-33,1	31,4-32,9	27,9-31,1	20,4-21,4	16,2-21,3	51
17.	*Viburnum lantana*	24,4-31,9	23,8-35,7	21,4-25,7	13,1-13,9	8,50-11,1	66
18.	*Viburnum opulus*	25,9-27,8	25,9-27,2	21,6-24,4	14,1-15,8	13,9-15,0	74

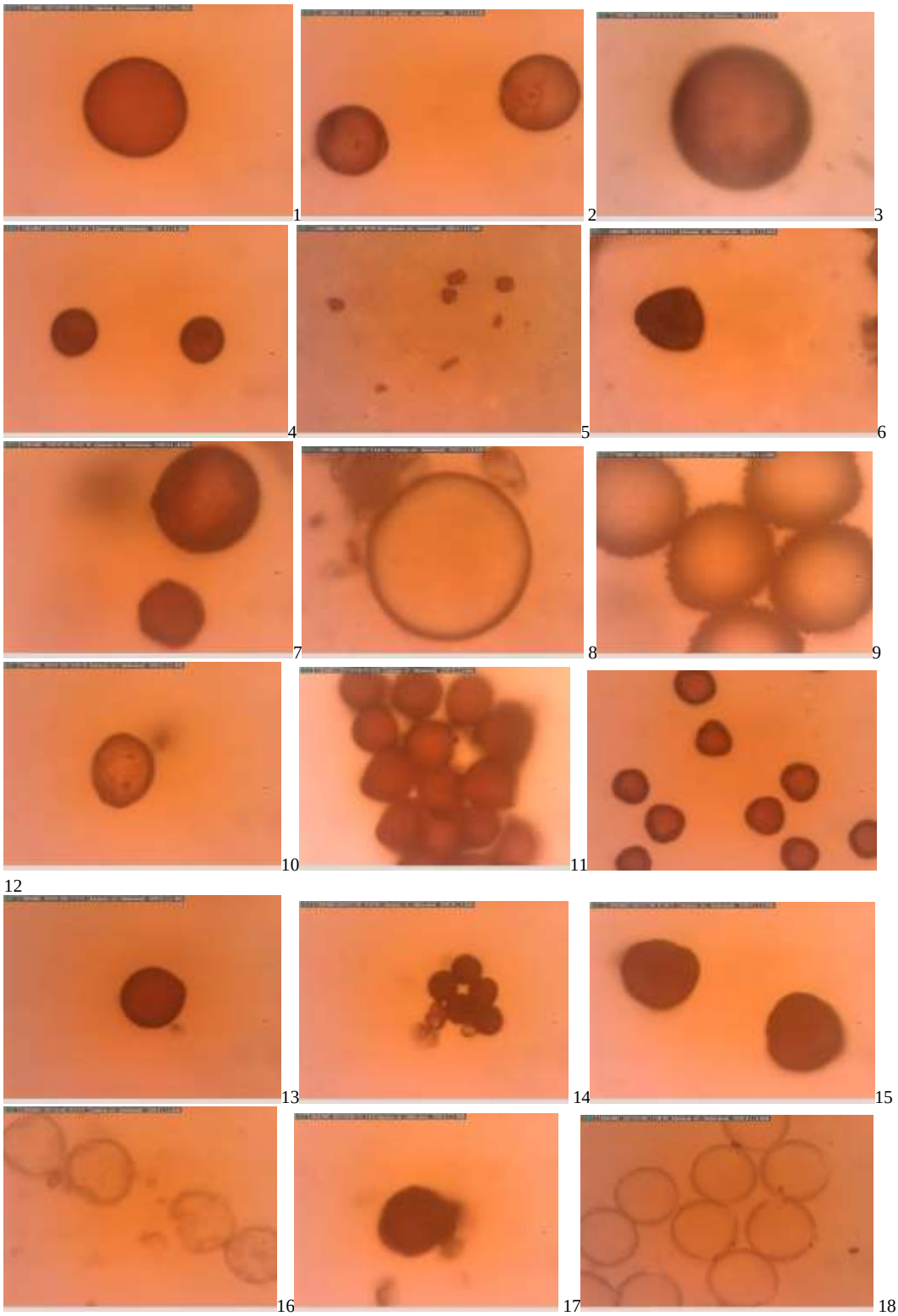

Figure 1. Microscopic view of the pollen of the studied species
1-*Acer campestre*, 2-*Carpinus caucasica*, 3-*Carpinus orientalis*,4-*Cornus mas*, 5-*Cotoneaster melanocarpus*, 6-*Cotoneaster multiflorus*, 7-*Fagus orientalis*,

8-*Lonicera caprifolium*, 9-*Lonicera xylosteum*,10-*Pterocarya pterocarpa*,11-*Pyracantha coccinea*, 12-*Salix caprea*,13-*Sorbus terminalis*, 14-*Tamarix ramossima*, 15-*Tilia begonifolia*,16-*Tilia cordata*,17-*Viburnum lantana*, 18-*Viburnum opulus.*

Large pollen grains were observed in *Lonicera caprifolium*(polar size 43.9-72.9 mkm, equatorial size 42.2-71.97 mkm) and *L.xylosteum*(polar size 47.7-56.3 mkm, equatorial size 46.7-50.5 mkm) species belonging to Lonicera genus (Caprifoliaceae). In these species, furrow length (29.1-52.9 mkm 41.7-46.98 mkm), mesocolpium width (22.9-35.9 mkm; 29.2-34.9 mkm), apocolpium diameter (25.9-48.2 mkm; 25.5-29.4 mkm) was high.

Pollen grains of the other studied species were of medium size. In these species, the smallest polar size was 13.5 mkm, and the largest equatorial size was 43.4 mkm. The furrow length varies between 6.2 to 34.5 mkm. The width of the mesocolpium was the lowest-5.90-7.80 mkm, the highest 21.8-22.9 mkm, the diameter of the apocolpium was the lowest 4.20-6.60 mkm, the highest 16.2-21.3 mkm.

During the research, the viability of the pollen of the species was also determined. Being one of the important indicators for introduced plants, it is one of the main factors showing how they adapt to new soil-climate conditions.

According to the research results, it can be said that the viability of the pollen of species introduced to Absheron is high (51-93%). *Acer campestre, Carpinus caucasica, Carpinus orientalis, Cornus mas, Fagus orientalis, Lonicera caprifolium, Lonicera xylosteum, Salix caprea, Tilia begonifolia, Cotoneaster multiflorus, Pyracantha coccinea, Sorbus torminalis, Viburnum lantana, Viburnum opulus* species had the highest viability (61-93%). This shows that their ability to pollinate and fertilize, as well as their productivity, is high. Other species (*Cotoneaster melanocarpus, Pterocarya pterocarpa, Tamarix ramossima, Tilia cordata*) had relatively low (42-57%) viability. The pollen of the species retained its viability despite being kept in a refrigerator for a long time under special conditions (at a temperature of 2-50 C). However, depending on weather and storage conditions, the viability of pollen can change.

Results

1. According to the results of the general microscopic analysis of the pollen of plants distributed in the northeastern part of the Greater Caucasus in ex situ conditions, species are divided into 3 groups according to the morphometric indicators of their pollen: 1. Species(*Cotoneaster melanocarpus, Tamarix ramosissima)* with small pollen. 2. Species(*Lonicera caprifoliim, L.xylosteum)* with large pollen. 3. Species(other studied species) with medium size of pollen.
2. The small polar size of the pollen of the studied species varied from 6.7 mkm to 47.7 mkm, and the large polar size varied from 6.9 mkm to 72.9 mkm. The large equatorial size of pollen grains was between 7.9 mkm and 71.97 mkm, and the small equatorial size was between 6.6 mkm and 46.7 mkm.

3. According to the research results, the viability of the pollen of the species introduced to Absheron was high, so that the viability was higher than 50% in most of the species. This is an indicator of their high pollination and fertilization ability and vitality.

References

[1] Arabzade A.A., Zeynalov Y.M., Morphology and viability of pollen of Niedzwetzky apple (Malus niedzwetzkyana Dieck.) introduced to Absheron, *Scientific Works of ANAS Institute of Botany*, **35** (2015), 136-139.

[2] Burmistrav A. N., Nikitina V.A., *Honey Plants and Their Pollen*, Moscow: Rosagropromizdat, 1990.

[3] Golubinskiy İ.N., *Biology of Pollen Germination*, Kyiv: Naukova Dumka, 1974

[4] Griqoreva V.V., Britsiy D.A., Bilyat A.V., Morphology of pollen grains of representatives of the genus Lonicera (Caprıfoliaceae) growing in the North-West of Russia, *Bot. Journal*, **99** (2014), no. 5, 529-539.

[5] Gvianidze D.M., Assessment of pollen quality of introduced oak species in Batumi, *Bull. Botanical Garden.*, **102** (1976), 72-74. https://doi.org/10.2307/2395310

[6] Hu, Ch.-Ch., He Ch.-X., Pollen morphology of Caprifoliaceae from china and its taxonomic significance, *Acta Phytotaxonomica Sinica*, **25** (1988), no. 5, 343-352.

[7] Kruqlova N.P., Assessment of the quality of pollen grains of flowering plants, *Bulletin SNBG*, **135** (2020), 50-56. https://doi.org/10.36305/0513-1634-2020-135-50-56

[8] Kupriyanova V.M., Aleshina L.A., Pollen of dicotyledonous plants of the flora of the European part of the USSR, *Botanical Journal*, **65** (1980), no. 2, 184-188.

[9] Narıshkina N.N., Morphology of East Asian pollen of representatives of the genus Quercus (Fagaceae), *Bot. Journal*, **100** (2015), no. 9, 873-885. https://doi.org/10.1134/s000681361509001x

[10] Makino M., Hayachi R., Takahara H., *Pollen Morphology of the Genus Quercus by Scanning Elecron Msroscore*, Scientific reports of Kyoto Prefectural University Life and Environmental Sciences, 61 (2009), 53-81.

[11] Mammedova K.A., Viability of pollen of Dagdagan species, pollination and fertilization. News of Pedagogical University, *Deartment of Natural Sciences*, **1** (2015), 83-86.

[12] Pausheva Z.P., *Workshop on Plant Cytology*, 4th ed. Reworked And additional M. Agropromizdat, 1988

[13] Petruk A.A., Morphology of pollen grains of 25 species of the genus Salix (Salisaceae) of Asian Russia according to electron microscopy data, *Bulletin SNBG*, **133** (2019), 94-101. https://doi.org/10.36305/0513-1634-2019-133-94-101

[14] Pimenov A.V.,Sedelnikova T.S., Efremov S.P., Morphology and quality of pollen of yellow and red anther forms of Pinus sylvestris in swamp and dry valley growing conditions(Tomsk region), *Bot. Journal*, **96** (2011), 367-376.

[15] Samigullina N.S., Workshop on selection and variety management of fruit and berry rops Michurinsk: MQAU, 2006

[16] Samutina M.L., Comparative morphological analysis of pollen of the genus Sambucus (Caprifoliaceae), *Botanical Journal*, **71** (1986), no. 2, 168-174.

Received: December 5, 2023; Published: December 20, 2023