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Plant pollination calendar of the Southern Coast of Crimea and elimination therapy at the resort

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ABSTRACT

BACKGROUND: Plant pollen can influence the climatotherapy and elimination therapy results of respiratory allergic diseases. Flora diversity and the poorly studied prevalence and etiology of pollinosis on the Southern Coast of Crimea determine the need for aeropalinological studies of this region to optimize the treatment and rehabilitation of patients with respiratory sensitization.

AIMS: To determine the potentially unfavorable periods for the stay of patients with pollen sensitization on the Southern Coast of the Crimea and develop a plant pollination calendar of the Yalta resort

MATERIALS AND METHODS: The research was conducted in the coastal and foothill area of Yalta in 2011–2013. The study determined the content of pollen in plants that are passively deposited from the air onto the glasses-traps using the gravimetric method. The taxonomic belonging of the pollen was established by collecting the plant pollen of the Southern Coast of Crimea.

RESULTS: A total of 19 pollen taxa have been identified in the air of Yalta, of which 10 had sensitizing properties. Cypress (49.7% of pollen of the average annual amount) and most deciduous trees with allergenic pollen (4.7% of pollen) were intensively pollinated in March–April, Poaceae grasses (1.6% of pollen) in May, and weed grasses (1.6% of pollen) in late August to early September. Birch and alder pollen was not detected. On average, 2.2 times less pollen was detected in the coastal area air of the resort than in the foothill area. The plant pollination calendar of the Yalta resort has been developed.

CONCLUSIONS: The intensive cypress pollination period in March–April is least favorable for patients with pollen sensitization to stay on the Southern Coast of the Crimea. Poaceae in May and weeds in late August to early September create an insignificant pollen load. A plant pollination calendar has been developed to predict unfavorable aeropalinological periods and optimize the treatment and rehabilitation of patients with pollen sensitization in the Yalta resort. The best conditions for the treatment and rehabilitation of patients with respiratory allergies have been identified in the coastal area of the resort. The absence of birch and alder pollen in the air contributes to the elimination therapy at the Yalta resort.

Keywords: Southern Coast of Crimea; climate resort; plant pollen; pollination calendar; pollinosis; elimination therapy

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Календарь палинации растений Южного берега Крыма и возможности элиминационной терапии на курорте

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АННОТАЦИЯ

ОБОСНОВАНИЕ. Пыльца растений может влиять на результаты климато- и элиминационной терапии респираторных аллергических заболеваний. Разнообразие флоры, малоизученность распространённости и этиологии поллиноза на Южном берегу Крыма определяют необходимость аэропалинологических исследований этого региона для оптимизации лечения и реабилитации больных с респираторной сенсибилизацией.

ЦЕЛЬ — определить периоды, потенциально неблагоприятные для пребывания на Южном берегу Крыма больных с пыльцевой сенсибилизацией; разработать календарь палинации растений Ялтинского курорта.
МАТЕРИАЛЫ И МЕТОДЫ. Исследования проводились в прибрежном и предгорном районах Ялты в 2011–2013 гг. Материал исследования — пыльца растений, пассивно оседавшая из воздуха на стёкла-ловушки. Содержание пыльцы в воздухе определялось гравиметрическим методом. Таксономическая принадлежность пыльцы устанавливалась с использованием коллекции пыльцы растений Южного берега Крыма.
РЕЗУЛЬТАТЫ. В воздухе Ялты идентифицировано 19 таксонов пыльцы, из них 10 — с сенсибилизирующими свойствами. Кипарис (49,7% пыльцы от среднегодовой суммы) и большинство лиственных деревьев с аллергенной пыльцой (4,7%) интенсивно пылили в марте-апреле, злаки (1,6%) — в мае, сорные травы (1,6%) — в конце августа — начале сентября. Пыльца берёзы и ольхи не обнаружена. В воздухе прибрежного района курорта выявлено в среднем в 2,2 раза меньше пыльцы, чем в воздухе предгорного района. Разработан календарь палинации растений Ялтинского курорта для прогнозирования неблагоприятных аэропалинологических периодов и оптимизации лечения и реабилитации больных с пыльцевой сенсибилизацией.
ЗАКЛЮЧЕНИЕ. Для пребывания на Южном берегу Крыма больных с пыльцевой сенсибилизацией наименее благоприятен период интенсивного пыления кипариса в марте-апреле. Злаки в мае и сорные травы в конце августа – начале сентября создают незначительную пыльцевую нагрузку. Наилучшие условия для лечения и реабилитации пациентов с респираторной аллергией выявлены в прибрежном районе курорта. Отсутствие в воздухе пыльцы берёзы и ольхи способствует проведению элиминационной терапии поллиноза на Ялтинском курорте.

Ключевые слова: Южный берег Крыма; климатический курорт; пыльца растений; календарь палинации; поллиноз; элиминационная терапия

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Background

Various pollinosis manifestations (allergic rhinitis and conjunctivitis, bronchial asthma, angioedema, etc.) are registered in up to 24% of the Russian population [1]. Its prevalence and etiology on the Southern Coast of Crimea (SCC) have not been sufficiently studied [2].

The SCC with the resorts of Big Yalta is the only region in Russia with a dry subtropical Mediterranean climate [3]. The air saturated with phytoncides of plants, aerosols of sea salts, light ions, and the warm sea predetermined the traditional (since the last third of the XIX century) use of the SCC for climatotherapy and rehabilitation of patients with bronchopulmonary diseases, and the absence of birch and alder predetermined elimination therapy (since the 1970s) [4].

The climatotherapy efficiency is largely determined by the air environment quality [4]; therefore, aerorespiratory therapy (air baths, dosed physical activity in fresh air, and helio- and thalassotherapy) is widely used at such resorts.

One of the aeropollutants is plant pollen (>700 species), which have a sensitizing effect on the body [5]. The SCC flora includes over 1000 species of introduced species, and most 2500 species are of Crimean wild plants [6]. A significant pollen load in this region during periods of intense plant pollination brings the risk of sensitization or exacerbation of respiratory allergic diseases, which diagnostics and treatment largely depend on aeropalinological monitoring results that causally identify significant aeroallergens, determine the periods of their increased content in the air, and draw up the plant pollination calendars to optimize the timing and approach of personalized treatment and rehabilitation of patients with pollen sensitization, complication prevention, and flexible specific immunotherapy timing regulation [7].

The study aimed to determine the periods that are potentially unfavorable for SCC stay for patients with pollen sensitization, as well as develop a plant pollination calendar in the Yalta resort.

Materials and methods

Study design

This is an observational single-center prospective full-design uncontrolled study.

Study conditions

The study was conducted in the scientific research department of pulmonology of the I.M. Sechenov Academic Research Institute of Physical Methods of Treatment, Medical Climatology, and Rehabilitation of the Ministry of Health of the Republic of Crimea within the planned research work “Aeropalinological monitoring of the city of Yalta to increase the sanatorium-resort treatment efficiency in its coastal and foothill areas”.

Study duration

The study was performed from 2011 to 2013. The monitoring was performed following the standard European method [8]. Plant pollination continuously occurs throughout the year in the SCC subtropical climate, thus the monitoring was performed without interruption, starting from January 03, 2011, to December 29, 2013, inclusive.

Description of the intervention

Aeropalinological studies were performed in the coastal (Shcherbaka str.) and foothill (Mukhina str.) areas of Yalta using the gravimetric method with weekly replacement of exposed trap glasses using the Durham's pollen trap [9] following Yu.M. Posevina recommendations [10]. Additionally, pollen deposition from the air was captured, identified, and quantitatively determined using visual counting in the field of view of a microscope of the number of pollen grains (PG) of each taxon and their total amount. Further, a plant pollination calendar in the air of Yalta was develop.

Durham's pollen traps were installed at a height of 10–20 m on building roofs. A thin layer of vaseline oil was applied to the glass surface before exposure. Then, glasses were replaced with new ones after exposure. The studied samples were not stained since living and dead PGs was not necessarily differentiated.

Main study outcome

During the monitoring period, 312 aeropalinological samples were collected and studied. Obtained data were entered into an electronic workbook and tables.

Additional study outcomes

The pollination calendar was drawn up in a table based on the obtained aeropalinological study results in the coastal and foothill regions and averaged over the entire monitoring period for the city as a whole.

Outcome registration methods

Settled PGs from the air were calculated using a LUMAM microscope (LOMO, St. Petersburg, Russia) at a magnification of 280. With subsequent recalculation per 1 cm^2, 100% of the total specimen area (12.5 cm^2 of the glass surface) was analyzed. Only undisturbed PGs were taken into account. The number of PGs of each taxon that settled per week was calculated, as well as the total number of all deposited PGs.

The taxonomic affiliation of PGs was identified using a preliminarily created collection of plant pollen [6]. Due to the significant morphological similarity of PGs of closely related species, their taxonomic affiliation in most cases was determined to the genus, and in some cases, to the family.

Statistical analysis

Principles for sample size calculation. The sample size was not pre-calculated.

During the monitoring period, 312 aeropalinological samples were collected and studied. Applied computer programs Microsoft 2007 and Excel were used for statistical data processing and graph plotting. The arithmetic means and their standard deviations (M±SD) were calculated.

Results

Research objects

The study object includes the qualitative and quantitative composition of plant pollen contained in the air of the coastal and foothill regions of Yalta.

Main research findings

During the study period, in addition to unidentified PG (UPG), plant pollens of 19 taxa was found in the air of the Yalta resort, namely conifers (cypress *[Cupressus]*, American arborvitae *[Thuja occidentalis]*, juniper *[Juniperus]*, pine *[Pinus]*, cedar *[Cedrus]*, and common yew *[Taxus baccata]*), deciduous trees and shrubs (ash-tree *[Fraxinus]*, hornbeam *[Carpinus]*, walnut *[Juglans regia]*, common hazel *[Corylus avellana]*, oak *[Quercus]*, poplar *[Populus]*, common privet *[Ligustrum vulgare]*, highest tree of heaven *ailanthus [altissima]*, cornel tree *[Cornus mas]*, boxtree *[Buxus colchica]*), herbs (poaceae *[Poaceae]*, hogweed *[Ambrosia]*, and weeds) (Table 1). Tree and shrub pollen prevailed (84.2% of the identified taxa and 88.8% of the average annual total PGs), mainly of conifers (79.3% of the average annual amount) such as cypress, pine, and cedar. The number of PGs of deciduous trees and shrubs as producers of pollen with sensitizing properties (ash-tree, hazel, oak, and poplar) amounted to 4.7% of the average annual amount, whereas 3.2% in herbaceous plants (poaceae and weeds, including hogweed) (Fig. 1).

Plant pollination in Yalta was naturally wavy. Wave 1 include tree pollination from mid-autumn to mid-summer (cedar in September to February; cypress in November to early May; hazel, ash-tree, yew, cornel tree, juniper, arborvitae, poplar, and walnut in January to April; hornbeam and boxtree in March to early May; and pine, oak, ailanthus, and privet in late April to mid-July). Wave 2 was mild due to the rapid drying or oppression of grasses during the drought period and include poaceae pollination in late April to early June. Wave 3, which is also mild, include weeds pollination from mid-July to early November (Fig. 2).

The largest amount of pollen in the air of Yalta was recorded in spring, which was 79.0% of the average annual amount (maximum in March). Significantly fewer PGs were revealed in summer, autumn, and winter in the air of the resort, which amounted to 7.7, 8.6, and 4.7% of the average annual amount, respectively (Table 2). The highest pollen content with sensitizing properties in the air was noted in mid-March to mid-April (cypress, hazel, and ash-tree pollination), the first 3 weeks of May (poaceae pollination), and late August to early September (weeds and hogweed pollination). The

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Table 1. The amount of plant pollen of various taxa detected in the air of Yalta in 2011–2013

Name of taxon	Amount of pollen grains deposited on 1 cm² of trap glasses																		
	Absolute amount, units										% of the annual amount								
	2011		2012		2013		Average annual (M±SD)			f.a./c.a.	2011		2012		2013		Average annual (M±SD)		
	c.a.	f.a.	c.a.	f.a.	c.a.	f.a.	c.a.	f.a.	city		c.a.	f.a.	c.a.	f.a.	c.a.	f.a.	c.a.	f.a.	city
TREES AND SHRUBS																			
Cypress	4175	2583	333	1970	1334	7473	1947±1627	4008±2462	2978±2328	2,1	53,1	32,8	29,3	41,8	59,5	61,8	51,9±13,0	48,8±12,6	49,7±12,6
Pine	1649	2835	35	828	97	2400	594±747	2021±862	1307±1077	3,4	21,0	36,0	3,0	17,6	4,3	19,9	15,9±8,2	24,6±8,2	21,9±11,1
Cedar	574	165	495	543	519	136	529±33	281±185	405±182	0,5	7,3	2,1	43,6	11,5	23,1	1,1	14,1±14,9	3,4±4,7	6,8±14,8
Ash-tree	533	75	45	138	18	376	199±237	196±130	198±191	1,0	6,8	1,0	4,0	2,9	0,8	3,1	5,3±2,5	2,4±0,9	3,3±2,0
Hornbeam	15	478	-	-	7	245	7±6	241±195	124±181	34,4	0,2	6,1	-	-	0,3	2,0	0,2±0,1	2,9±2,5	2,1±2,2
Walnut	-	18	-	6	-	619	-	214±286	107±229	-	-	0,2	-	0,1	-	5,1	-	2,6±2,3	1,8±1,9
Boxtree	35	76	-	13	22	119	19±14	69±44	44±41	3,6	0,4	1,0	-	0,3	1,0	1,0	0,5±0,4	0,8±0,4	0,7±0,4
Hazel	138	11	11	45	-	14	50±63	23±15	37±47	0,5	1,7	0,1	1,0	1,0	-	0,1	1,3±0,7	0,3±0,4	0,6±0,6
Arborvitae	57	54	-	21	-	3	19±27	26±21	23±24	1,4	0,7	0,7	-	0,5	-	0,0	0,5±0,3	0,3±0,3	0,4±0,3
Oak	-	-	3	23	2	101	2±1	41±42	22±36	20,5	-	-	0,3	0,5	0,1	0,9	0,1±0,1	0,5±0,4	0,4±0,3
Poplar	-	88	-	-	-	42	-	43±36	22±33	-	-	1,1	-	-	-	0,4	-	0,5±0,5	0,4±0,4
Yew	-	-	-	10	-	123	-	44±56	22±45	-	-	-	-	0,2	-	1,0	-	0,5±0,4	0,4±0,4
Ailanthus	-	-	-	35	6	12	2±3	16±15	9±12	8,0	-	-	-	0,7	0,3	0,1	0,1±0,1	0,2±0,3	0,1±0,3
Juniper	28	8	9	5	-	-	12±12	4±3	8±9	0,3	0,4	0,1	0,8	0,1	-	-	0,3±0,3	0,1±0,05	0,1±0,3
Privet	-	-	28	-	-	-	9±13	-	5±10	-	-	-	2,4	-	-	-	0,2±1,1	-	0,1±0,9
Cornel tree	-	-	-	-	5	-	2±2	-	1±2	-	-	-	-	-	0,2	-	0,1±0,1	-	0,02±0,07
HERBS																			
Poaceae	330	106	-	110	-	15	110±156	77±44	94±115	0,7	4,2	1,4	-	2,3	-	0,1	2,9±2,0	0,9±0,9	1,6±1,5
Hogweed	38	179	31	39	16	69	28±9	96±60	62±55	3,4	0,5	2,3	2,7	0,8	0,7	0,6	0,8±1,0	1,2±0,8	1,0±0,9
Weeds	-	-	-	-	94	136	31±44	45±64	38±56	1,5	-	-	-	-	4,2	1,1	0,8±2,0	0,6±0,5	0,6±1,5
IPG	7572	6676	990	3786	2120	11 883	3561±2872	7445±3350	5506±3677	2,1	96,3	84,9	87,1	80,3	94,5	98,3	95,0±4,0	90,6±7,6	92,0±6,5
UPG	291	1190	146	927	124	201	187±74	773±418	480±419	4,1	3,7	15,1	12,9	19,7	5,5	1,7	5,0±4,0	9,4±7,6	8,0±6,5
Total	7863	7866	1136	4713	2244	12 084	3748±2945	8218±3020	5986±3728	2,2	100	100	100	100	100	100	100	100	100

N o t e : c.a.: coastal area; f.a.: foothill area; IPG: identified pollen grains; UPG: unidentified pollen grains.

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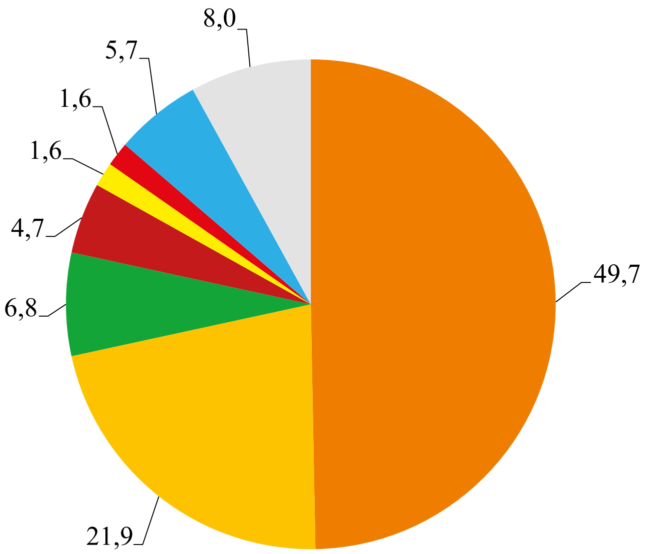

Fig. 1. Average annual aeropalinogram of the city of Yalta in 2011–2013, %.

Note. ■ — cypress, ■ — pine, ■ — cedar, ■ — deciduous trees with allergenic pollen (ash, hazel, oak, poplar), ■ — Poaceae, ■ — weeds, including ragweed, ■ — other trees and shrubs (hornbeam, walnut, ailanthus, privet, dogwood, thuja, yew, juniper, boxwood), ■ — unidentified pollen grains.

created pollen load in the atmosphere by trees, especially cypress trees, in March was ten times higher than that created by herbaceous plants in May and late August to early September (Fig. 2).

Based on the obtained data, a plant pollination calendar was drawn up, which demonstrates that plant pollen was present in the air of the Yalta resort all year round (Table 3).

Additional research findings

The study period revealed no such widespread aeroallergens as birch and alder pollen in the air of the Yalta resort.

The best aeropalinological situation was established in the coastal area of Yalta compared with the foothill area of the city. Thus, on average, a lower content of PGs of most taxa (cypress, pine, ash-tree, hazel, oak, poplar, weeds, hogweed, and UPGs) was revealed per year in the air of the coastal region, as well as the total content of PGs (Table 1). Only in November and December, the total content of aerosol pollen was higher in the air of the coastal region (Table 2).

Discussion

Summary of the main research finding

The largest amount of air-aerosol pollen with sensitizing properties was recorded in the Yalta resort in the second half of March, during the period of intense cypress (765 PG/cm^2 per week) and ash-tree (18.7 times less than the maximum content of cypress pollen) pollination. The maximum content of poaceae pollen in the air at the beginning of May was 26.4 times less than the maximum content of cypress pollen and 42.5 times less of hogweed pollen at the end of August (Fig. 2).

Discussion of the main research result

Of the 19 taxa of identified plant pollen in the air of the Yalta resort, 10 (cypress, arborvitae, juniper, hazel, ash-tree, oak, poplar, poaceae, hogweed, and other weeds) have sensitizing properties. The sensitizing properties of plant pollen of the cypress family (cypress, arborvitae,

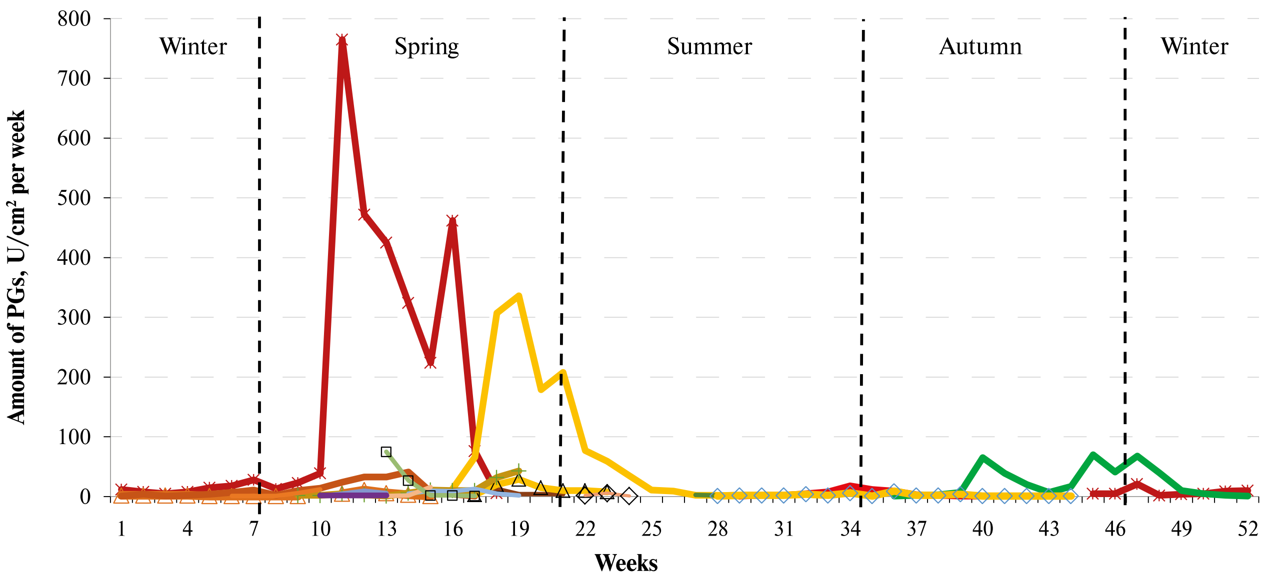

Fig. 2. Average annual dynamics of plant pollen content in the air of Yalta in 2011–2013, PG/cm^2 per week.

Note.

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Table 2. The total amount of plant pollen detected in the air of Yalta in 2011–2013

Month	Amount of pollen grains deposited on 1 cm² of glass																		
	Absolute amount, units										% of the annual total pollen of all taxa								
	2011		2012		2013		Average annual (M±SD)			f.a./ c.a.	2011		2012		2013		Average annual (M±SD)		
	c.a.	f.a.	c.a.	f.a.	c.a.	f.a.	c.a.	f.a.	city		c.a.	f.a.	c.a.	f.a.	c.a.	f.a.	c.a.	f.a.	city
January	9	51	43	106	8	181	20±16	113±53	67±61	5,7	0,1	0,6	3,8	2,2	0,4	1,5	0,6± 1,7	1,4±0,7	1,1±1,3
February	81	109	59	56	35	533	58±19	233±213	146±175	4,0	1,0	1,4	5,2	1,2	1,6	4,4	1,7±1,9	2,9±1,5	2,5±1,7
March	1764	1409	197	1406	1222	5396	1061±651	2737±1880	1899±1637	2,6	22,4	17,9	17,4	29,8	54,4	44,7	28,3±16,4	33,9±11,0	32,0±13,9
April	3221	1446	160	651	156	2892	1179±1444	1663±928	1421±1237	1,4	41,0	18,4	14,1	13,8	6,9	23,9	31,3±14,7	20,5±4,1	24,0±10,8
May	1806	2499	40	1213	133	2459	660±811	2057±597	1359±998	3,1	23,0	31,8	3,5	25,7	5,9	20,4	17,6±8,7	25,5±4,7	23,0±10,3
June	90	1228	36	344	31	42	52±27	396±503	224±431	7,6	1,2	15,6	3,2	7,3	1,4	0,3	1,4±0,9	4,9±6,3	3,8±5,3
July	51	122	47	160	17	24	38±15	102±57	70±53	2,7	0,7	1,6	4,1	3,4	0,8	0,2	1,0±1,6	1,3±1,3	1,2±1,5
August	137	449	68	121	45	129	83±39	233±153	158±134	2,8	1,7	5,7	6,0	2,6	2,0	1,1	2,2±2,0	2,9±1,9	2,7±1,9
September	82	152	50	74	51	87	61±15	104±34	83±34	1,7	1,0	1,9	4,4	1,6	2,3	0,7	1,6±1,4	1,3±0,5	1,4±1,2
October	141	64	25	450	202	29	123±73	181±191	152±147	1,5	1,8	0,8	2,2	9,6	9,0	0,2	3,3±3,3	2,2±4,3	2,6±3,9
November	309	279	381	95	284	281	325±41	218±87	272±86	0,7	3,9	3,6	33,5	2,0	12,6	2,3	8,7±12,4	2,7±0,7	4,6±11,3
December	172	58	30	37	60	31	87±61	42±12	65±49	0,5	2,2	0,7	2,6	0,8	2,7	0,3	2,3±0,2	0,5±0,2	1,1±1,0
Total	7863	7866	1136	4713	2244	12 084	3747±2945	8079±3020	5916±3728	2,2	100	100	100	100	100	100	100	100	100

Note: c.a.: coastal area; f.a.: foothill area.

and juniper) and hogweed are very strongly pronounced; those of poaceae is strongly pronounced, hazel, ash-tree, oak, and weeds are moderately pronounced, and poplar are weakly pronounced [10]. The abundance (47.9% of the total PGs) and very strong sensitizing properties of cypress pollen determined its role as the main aeroallergen in the SCC.

The analysis of changes over time and taxonomic composition of aerosol plant pollen established that the period from middle to late March is potentially most unfavorable for patients with pollen sensitization in the Yalta resort when cypress, ash-tree, and hazel have intensive pollination. The role of herbaceous pollen in the formation of the risk of sensitization and exacerbations in patients with pollen sensitization at the Yalta resort is insignificant, because hot weather and the accompanying drought, lasting from May to mid-autumn, oppress the grasses, shorten the duration, and reduce the intensity of their pollination. Thus, pollination of poaceae in May and weeds in late August to early September on the SCC is weakly pronounced.

In the summer and autumn period, which is the most favorable for the treatment and rehabilitation of patients with bronchopulmonary diseases and pollen sensitization on the SCC, the amount of pollen in the air of the Yalta resort is minimal, amounting to 10.7% of the average annual amount of registered PGs in summer and 9.9% in autumn, when pollen from trees with sensitizing properties is completely absent in the resort air.

Based on the obtained data, a plant pollination calendar was compiled, which is required for predicting unfavorable aeropalinological periods in the Yalta resort.

Additionally, the study established that the aeropalinological situation in the coastal region of Yalta is better than the foothill region of the city. Thus, for most of the year, a smaller (average of 2.2 times) total number of PGs was recorded in the coastal region, as well as a lower number of PGs for most (12 out of 19) taxa. Only in November and December, the situation oppositely changes. This indicates the preference for the elimination therapy of polyposis in the coastal region of the Yalta resort. Moreover, the absence in the SCC air of the main causally significant aeroallergens in the forest and taiga zones of Russia, namely the pollen of birch and alder, and the content of pollen of herbaceous plants (poaceae, hogweed, and other weeds), which is significantly lower than in most steppe and forest-steppe regions of Russia, as well as the discrepancy between the timing of their intensive pollination on the SCC and the mainland of Russia [1, 5, 6, 8, 11–15] favor the use of the Yalta resort for the elimination therapy of polyposis.

Study limitations

The gravimetric method that we used is not quantitative and does not calculate the pollen concentration in 1 m^3 of air. The amount of deposited pollen on the glasses that were determined using this method depends on weather conditions. The volumetric method, contrary to the gravimetric method, is more optimal and determines the daily dynamics and the amount of PGs in 1 m^3 of air to estimate the threshold pollen concentration; therefore, performing further aeropalinological studies at the SCC is advisable using the volumetric method, covering the recreational areas and territories of sanatoriums.

Conclusion

Of the 19 identified pollen taxa in the air of the Yalta resort, 10 (cypress, arborvitae, juniper, ash-tree, hazel, oak, poplar, poaceae, hogweed, and weeds) have sensitizing properties. Cypress pollen is the main aeroallergen on the SCC, which creates the greatest risk of respiratory allergy sensitization and exacerbation.

The periods of intense pollination of cypress (mid-March to mid-April), as well as, but to a much lesser extent, herbaceous plants, namely poaceae (the first 3 weeks of May) and weeds (late August to early September), with the pollen content in the air probably not exceeding the threshold values, are potentially unfavorable for patients with pollen sensitization to stay at the Yalta resort. The lowest content of plant pollen in the air of the Yalta resort was recorded from June to February.

A plant pollination calendar has been developed, which is used to predict the onset of unfavorable aeropalinological periods and optimize the treatment and rehabilitation of patients with pollen sensitization on the SCC, as well as adjust the timing of allergen-specific immunotherapy.

Differences between the SCC and other regions of Russia in the taxonomic composition of air-aerosol pollen and the timing of plant pollination, as well as the absence of birch and alder pollen in the atmosphere of the SCC, indicate the advisability of treatment and rehabilitation of pollen-sensitive patients at this resort, including elimination therapy for polyposis. The most favorable aeropalinological conditions are registered in the coastal area of the Yalta resort.

Extending the area of aeropalinological monitoring at the SCC to recreational areas and territories of sanatorium-resort institutions is advisable using the volumetric method.

Additional information

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Authors' contribution. S.N. Belyaeva — development of the concept and design of the study, analysis of the research results and literary sources, editing of the text of the article; M.E. Pirogova — processing and analysis of the results of microscopic examination of pollen, collection of literary sources, preparation and writing of the text of the article; M.I. Govorun — microscopic study of pollen deposited on slides, identification of its

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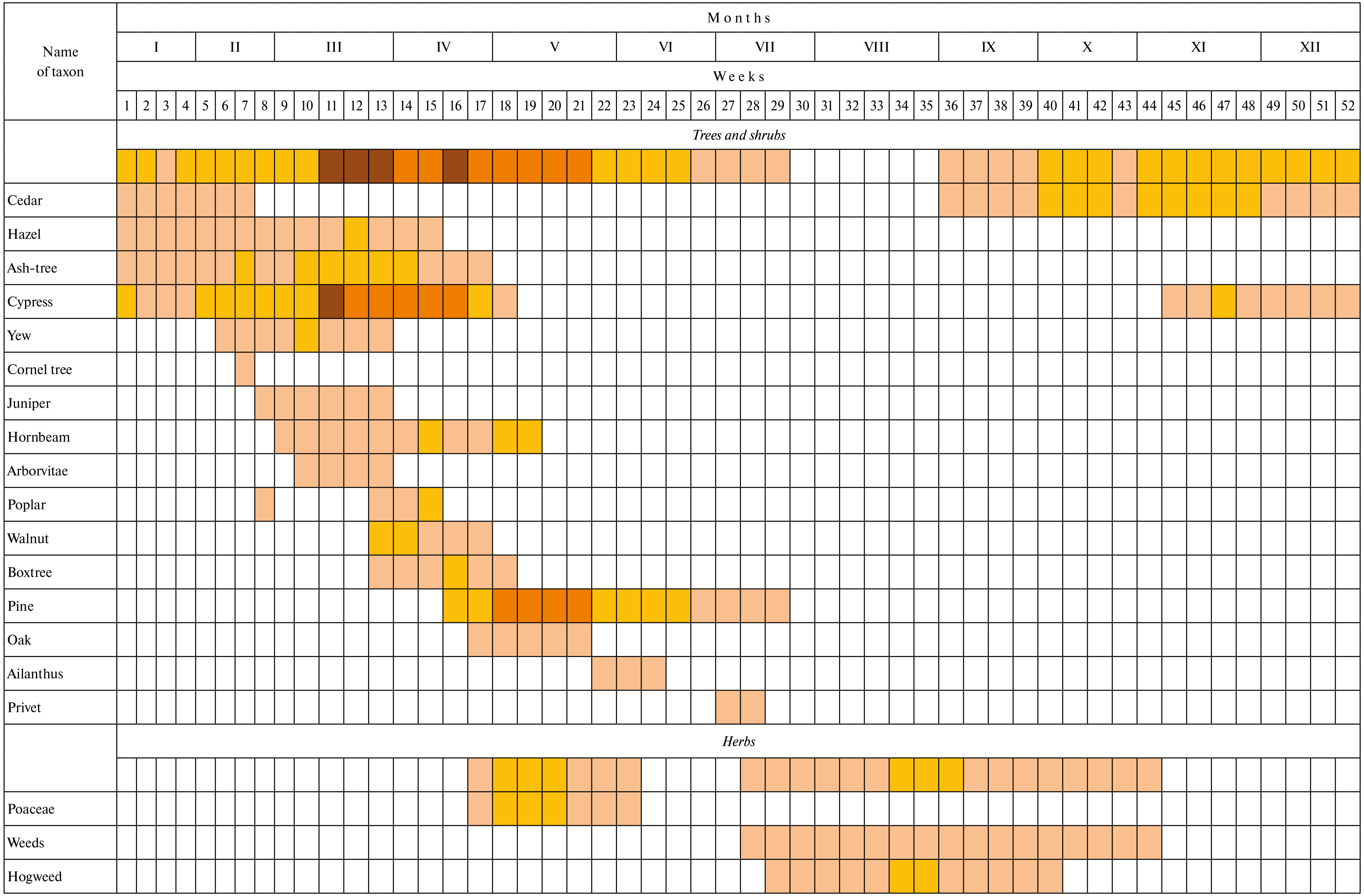
Table 3. Plant pollination calendar in the Yalta resort in 2011–2013



N o t e . Amount of pollen in the air: ▢ — minor, ▢ — moderate, ▢ — significant, ▢ — very significant.
For trees: insignificant amount — 1–10 PG/cm², moderate — 11–100 PG/cm², significant — 101–500 PG/cm², very significant amount — >500 PG/cm².
For herbs: insignificant amount — 1–10 PG/cm², moderate — 11–50 PG/cm², significant — 51–100 PG/cm², very significant amount — >100 PG/cm².

taxonomic affiliation and calculation of its quantity. All authors made a substantial contributions to the development of the conception of the work, acquisition, analysis, interpretation of data for the work, the conduct of research, drafting and revising the work, final approval of the version to be published, read and approved the final version before publication, and agree to be responsible for all aspects of the work.

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