論　　説

空中花粉の季節変動*

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Seasonal variation in the numbers of airborne pollen grains*

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Summary

Using Edwards' method seasonal variations in the number of airborne pollen grains were demonstrated. In more homogeneous groups of pollen, the parameters of seasonal trends are confirmed to be statistically significant.

Methods

It is well known fact that each flowering plants show the characteristic seasonal variations in the number of airborne pollen grains emitted from them.

For detecting and approximately estimating seasonal variation,[1] an ingenous method was devised by J. H. Edwards.[2][3][4] In his method the data are presented in the form of the rim of a circle divided into equal sectors, corresponding to the time intervals, and a number in each rim-sector is specified the number of events observed. In the absence of any cyclic trend the expected center of gravity of these masses will be at the center of the circle. Any excess or deficit in neighbouring sectors will have a consistent effect on the position of the center of gravity whose distance from the center will have a probability distribution of the null hypothesis and whose direction will indicate the position of maximum or minmum liability or both.

In the present paper, allows the data for numbers of airborne pollen grains for two years periods which the authors have already described in the previous paper,[5][6][7] to be considered from this point of view.

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Results

Table 1 gives six categories of classifications[8] of airborne pollens as already described in the previous papers.

Table 1 The classification of types of pollen grains from selected plants.

a) 3B 1-aperturate

Cryptomeriaceae

Cryptmeria japonica D. Don.

Cephalotaxaceae

Cephalotaxus harringtonia (Knight) K. Koch

Cupressaceae

Chamaecyparis obtusa Endl.

Chamaecyparis pisifera Endl.

b) $3C^{ab}$1-aperturate

Pinaceae

Pinus densiflora Sieb. et Zucc.

Pinus thunbergii Parl.

Abietaceae

Picea abies (L.) Karsten

c) $3A^{a(1-3)}$ Ulcerate

Gramineae only

Alopeculus aequalis Sobol. var. amurensis Ohwi

Koeleria tokiensis Domin

Agropyrum ciliare Franch.

Zizania latifolia Turez.

Eragrostis ferruginea Beauv.

Eleusin indica Gaertn.

d) $6B^{b}$ 3-Colporate

Compositae only

Ambrosia elatior L.

Ambrosia trifida L.

Artemisia princeps Pamp.

Artemisia japonica Thunb.

e) $4A^{a}$ Forminorate,

$5A^{a-c}$ Porate,

$5A^{b-c}$, $6A^{c}$ Poroidate

Juglandaceae

Juglans sieboldiana Maxin.

Betulaceae

Alnus spp.

Ulmaceae

Zelkowa serrata Makino

Celtis sinesis Pers. var. japonica Nakai

Moraceae

Humulus japonica Sieb. et Zucc.

f) Others

$6B^{b}$ 3-colporate (except *Compositae*)

Fagaceae

Castanea crenata Schneid.

Leguminosae

Astragalus sinicus L.

$4C^{ab}$ Forate

Chenopodiaceae

Chenopodium ambrosioides L.

Chenopodium album L.

Amaranthaceae

Amaranthus viridis L.

Plantaginaceae

Plantago lanceolata L.

Table 2 presents data for a number of airbornen pollen grains ($6B^b$ 3-colporate, Compositae) collected in 1969 and gives estimates of the values of parameters there, definied α, θ and the sampling variances of the former.

α defines the amplitude in trend of proportional oscillation about the mean, and θ defines the phase of maximum incidence (number) and is also given to the nearest peak's month.

The resulting diagram is given Fig. 1.

Fig. 2 gives the centers of gravities for 6 categories of airborne pollen grains in two years (1969 and 1970). In some pollen (×c, ×e, ×f, in Fig. 2) which have two or three peaks in one year as already reported in the previous paper, the centers of gravity showed the different phases showing midway between two or three peaks months.

But, other pollen (●a, ●b, ●d, ●f in Fig. 2) the seasonal variation are confirmed, which show the same phase with greater amplitudes. The pollen types (a. b. d. f) are considered to be rather homogeneous groups than the former, and the parameters of seasonal trends are revealed to be statistically significant with x^2 test as shown in Table 2.

Table 2. Calculation of seasonal trends by Edwards' method ($6B^b$ 3-colporate Compositae 1969)

Month	No. of pollen (n)	%	θ	$\sqrt{n}$	$\sin(\theta-15^\circ)$	$\sqrt{n}\sin(\theta-15^\circ)$	$\cos(\theta-15^\circ)$	$\sqrt{n}\cos(\theta-15^\circ)$
January	—	—	15°	—	0.000	—	+ 1.000	—
February	—	—	45°	—	+ 0.500	—	+ 0.866	—
March	—	—	75°	—	+ 0.866	—	+ 0.500	—
April	—	—	105°	—	+ 1.000	—	0.000	—
May	1	0.5	135°	1.00	+ 0.866	+ 0.87	− 0.500	− 0.50
June	—	—	165°	—	+ 0.500	—	− 0.866	—
July	—	—	195°	—	0.000	—	− 1.000	—
August	50	22.7	225°	7.07	− 0.500	− 3.54	− 0.866	− 6.12
September	145	65.9	255°	12.04	− 0.866	− 10.43	− 0.500	− 6.02
October	16	7.3	285°	4.00	− 1.000	− 4.00	0.000	0.00
November	7	3.2	315°	2.65	− 0.866	− 2.29	+ 0.500	+ 1.33
December	1	0.5	345°	1.00	− 0.500	− 0.50	+ 0.866	+ 0.87
	N = 220	100.0		W = 27.76		S = − 19.89		C = − 10.44

$$d = \frac{\sqrt{S^2+C^2}}{W} = 0.8092 \qquad \mathrm{Var}\ \alpha = \frac{2}{N} = 0.00909$$

$$\alpha = 4d = 3.24 \qquad x^2 = \frac{1}{2}N\alpha^2 = 1154.7\ (\mathrm{df}=2)$$

$$(\theta-15^\circ) = \tan^{-1}S/C = 242\frac{1}{2}^\circ$$

$$\theta = 257\frac{1}{2}^\circ \text{ (i. e. middle September)}$$

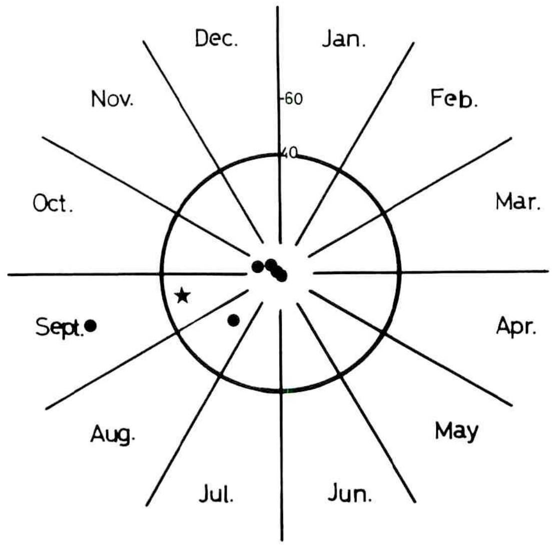

Fig. 1. Intensity and direction of seasonal varistion in $6B^b$ 3-colporate (Compositae) in 1969

★ Center of gravity

● Monthly values

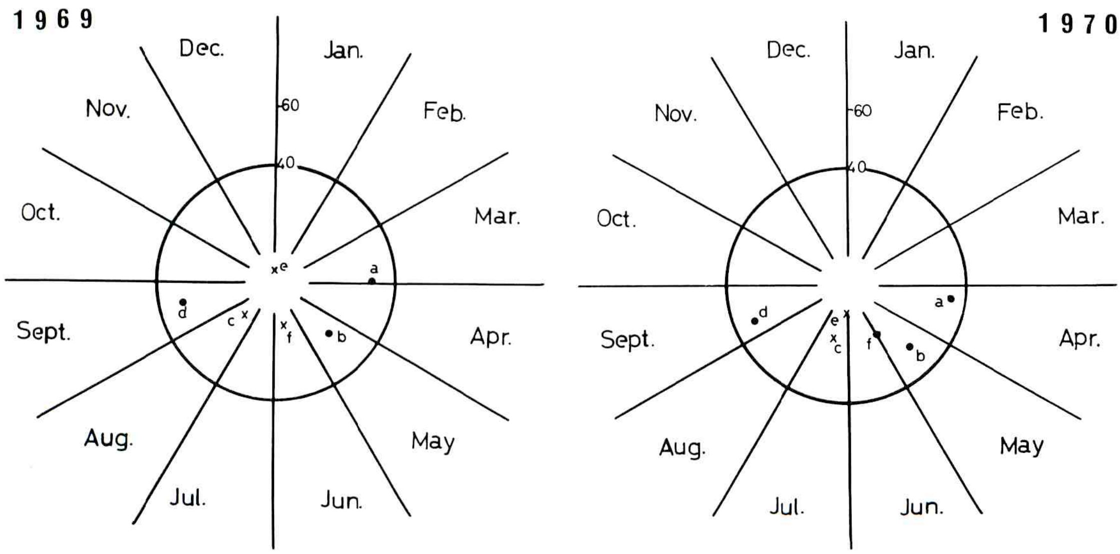

Fig. 2. Seasonal variation in the proportion of airborne pollen grains with various types in 1969 and 1970

a. 3B 1-aperturate

b. $3C^{ab}$ 1-aperturate

c. $3A^{a(1-3)}$ Ulcerate (Gramineae)

d. $6B^b$ 3-colporate (Compositae)

e. $4A^a$ Forminorate, $5A^{a-c}$ $6A^c$ poroidate

f. Others

Referance

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筆者らは、既に各植物の花期に放出される花粉の大気中濃度が特有の季節変動を有することを報告した。

本報では、Edwardsの季節変動の円形表示法（重心法）を用いて、既報の著者らの2年間の空中花粉のデーターを検討した。

1969年と1970年のデーターを6つの花粉型別に分類し、それぞれの月別花粉数より重心を求め、これを年度別に、2つのグラフ上6つの点として表示することができた。この花粉型のうち、年間に1つのピークをもつものでは、その重心は花粉数のピークを示す月に一致した。また、花粉型のうち近縁種のもののみのグループでは季節変動のパラメーターはx^2検定で有意であった。