

AIR-BORNE MOLDS IN HONOLULU

W. A. MYERS, M.D., HONOLULU, HAWAII

THE primary purpose of this survey was to compare counts of air-borne mold spores in Honolulu with similar surveys in mainland cities.⁷ In this way, we hoped to be able to evaluate better the relative importance of this factor on the incidence of respiratory allergy in Hawaii. In addition to this, we attempted to evaluate various factors that may influence the spore counts.

METHOD

Standard-sized (9 cm. in diameter) Petri dishes containing medium recommended by the Subcommittee on Mold Survey of the American Academy of Allergy^{1, 7, 9} were exposed for twelve minutes at about noon on the balcony of the second floor of our clinic building in Honolulu. The colonies were identified and counted four or five days after exposure by two members of our laboratory staff.

A total of 248 plates were exposed over a period of sixteen months. Total colonies counted were 1,803. We believe that the data from the last six months of the survey are the most accurate because of experience gained in identification of colonies during the first few months, so data from these months, totaling 139 plates and 1,273 colonies, are used in this discussion, except in Fig. 1. Daily counts were made during this time, except for week ends.

Fifteen different genera were identified, as shown in Table I. These corresponded fairly closely with a survey reported by Halde⁶ in 1950. However, we did not attempt to identify the relatively uncommon types. It will be noted that *Alternaria*, which along with *Hormodendrum* is the most common mold spore found in many mainland surveys, is seldom found here.^{2, 3, 5, 7-9, 11}

The percentage of the more common spore colonies to the total count is shown in Table I. This table also shows the average number of colonies per plate for the survey and the range of the monthly averages of colonies per plate from the lowest to the highest monthly average.

Table II shows that Honolulu has lower monthly average plate counts and also lower peak counts, than most of the mainland cities for both *Hormodendrum* and *Alternaria* and for total spore counts.

It was found that over a period of sixteen months the monthly spore counts of *Hormodendrum* (comprising one-third of the total spore counts) and the total monthly spore count formed parallel graphs.

As seen in Fig. 1, the average spore count per plate per month does not vary a great deal from month to month, but tends to be slightly higher in the

From the Department of Pediatrics, Straub Clinic, Honolulu, Hawaii.
Received for publication April 2, 1956.

TABLE I. FUNGI ISOLATED FROM 139 PLATES EXPOSED IN HONOLULU DURING SIX MONTHS OF 1953

COLONY	TOTAL COUNT	PER CENT OF TOTAL	AVERAGE PER PLATE	EXTREMES OF AVERAGE OF COLONIES PER PLATE PER MONTH	
				LOW	HIGH
Hormodendrum	430	33.5	3.1	0.8	6.5
Aspergillus	134	10.0	0.9	0.4	1.6
Monilia	110	9.0	0.8	0.0	1.3
Penicillin	83	7.0	0.6	0.3	1.2
Fusarium	71	6.0	0.5	0.2	1.0
Mycelia Ster.	35	3.0	0.3	—	—
Torula	24	2.0	0.2	—	—
Yeast	13	1.0	0.1	—	—
Paecilomyces	11	—	—	—	—
Alternaria	10	—	—	—	—
Pullularia	9	—	—	—	—
Oospora	4	—	—	—	—
Helminthosporium	1	—	—	—	—
Rhizopus	1	—	—	—	—
Others	3	—	—	—	—
Unidentified	340	27	2.4	—	—

TABLE II. AVERAGE NUMBER OF MOLD COLONIES PER PLATE AS FOUND IN HONOLULU COMPARED WITH SOME MAINLAND CENTERS

CENTER	HORMODENDRUM		ALTERNARIA AVERAGE FOR 6 MOS.	TOTAL MOLD COUNTS AVERAGE FOR 6 MOS.
	AVERAGE FOR 6 MOS.	HIGHEST MONTHLY AVERAGE		
Honolulu, Hawaii	3.6	6.3 (Aug.)	0.07	9.55
Des Moines, Iowa	21.0	33.3 (Aug.)	11.0	60.0
Los Angeles, Calif.	19.6	33.0 (May)	5.30	40.0
Madison, Wis.	19.6	43.3 (Oct.)	18.9	50.0
Santa Barbara, Calif.	7.3	11.2 (May)	2.50	18.0
San Diego, Calif.	7.1	11.0 (May)	1.12	21.0
Oklahoma City, Okla.	7.0	15.6 (May)	10.7	27.2
Ann Arbor, Mich.	3.7	7.8 (Sept.)	10.7	28.8
Richmond, Va.	2.4	3.8 (Sept.)	7.1	27.0
Oakland, Calif.	1.5	5.0 (Oct.)	0.37	6.0
Chicago, Ill.	0.3	3.0 (Oct.)	18.0	?
Tucson, Ariz.	0.1	0.6 (Sept.)	1.0	11.0

TABLE III. INFLUENCE OF LOCAL WIND VELOCITY ON SPORE COUNTS

MONTH	WINDY		NORMAL BREEZE		CALM	
	NO. DAYS	AVERAGE COUNT	NO. DAYS	AVERAGE COUNT	NO. DAYS	AVERAGE COUNT
November	4	4.7	8	11.0	11	4.5
December	4	42.7	10	9.0	14	7.0
January	3	24.0	14	10.7	8	8.0
Total	11	71.4	32	30.7	33	19.5

TABLE IV. COMPARISON OF THE EFFECT OF PREVAILING "KONA" (SOUTH) AND TRADE (NORTHEAST) WINDS ON THE SPORE COUNTS

"KONA" WINDS			"TRADE" WINDS	
BREEZY	CALM		BREEZY	CALM
12.6	7.0		12.9	4.3
Total 19.6			Total 17.2	

winter months. According to Alvarez and Castro,¹ this is also true in Havana, Cuba. This curve did not seem to correlate with monthly precipitation, absolute humidity, direction of prevailing winds or the temperature, as reported by the local weather bureau.

A comparison of the monthly incidence of onset of attacks of asthma seen in our pediatric department¹⁰ and the monthly total spore counts did not seem to be related in 1953, as shown in Fig. 1. Apparently the most important factor in the individual plate counts was the amount of local wind at the time the plates were exposed, as shown in Table III. This was also found to be true in several other similar surveys on the mainland and in Cuba.¹⁻³ (*Note: A notation was made of the wind velocity and direction at the time the plates were exposed during November, December, and January, 1953-54.*)

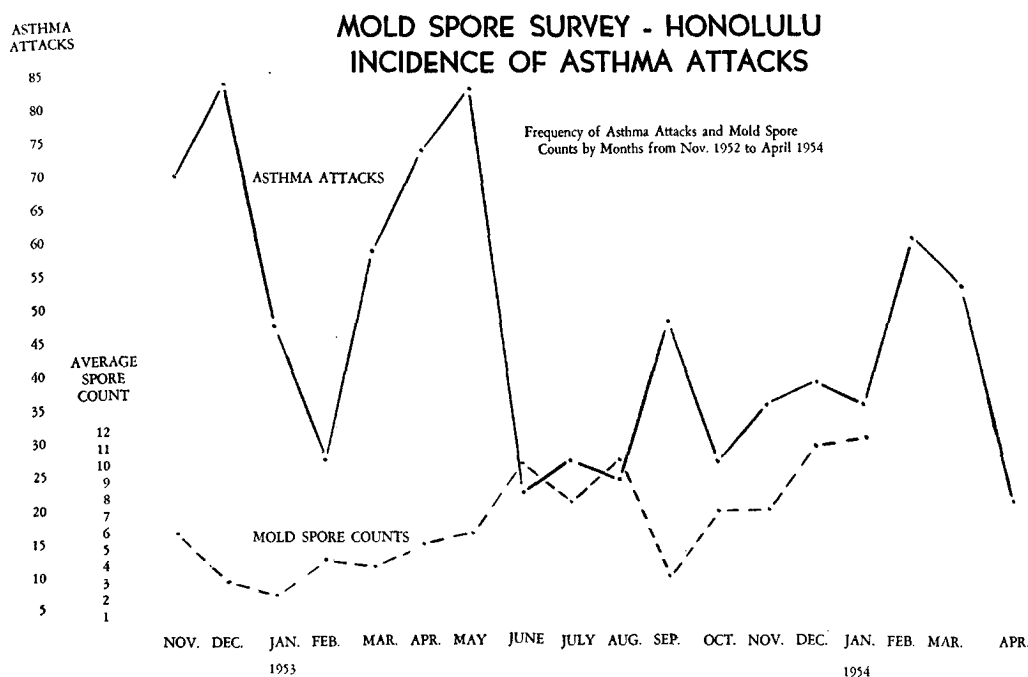


Fig. 1.—The monthly incidence of attacks of asthma in children seen by us in Honolulu as compared with the average spore counts per plate for each month.

Table IV compares the spore counts with regard to the wind direction and velocity at the time of exposure. During December and January, the direction of the prevailing wind was noted at the time of exposure of the plates. It will be noted that the wind direction had little or no influence on the spore counts at this location in Honolulu (one mile north of the coast and one mile south of the mountains in central Honolulu.)¹⁰

In 1952, Alvarez and Castro¹ pointed out the importance of wind velocity as a factor in evaluating spore counts in the air, and described a method of reducing this factor to a minimum by counting the spores in a constant volume of stationary air within an enclosed cabinet.

TABLE V. THE AVERAGE NUMBER OF MOLD COLONIES PER PLATE OBTAINED AT VARIOUS TIMES OF THE DAY BY THE "AIR SAMPLER," IN HONOLULU

	A.M.		P.M.	
	12 TO 6 2400 TO 0600	6 TO 12 0600 TO 1200	12 TO 6 1200 TO 1800	6 TO 12 1800 TO 2400
Samples	8	18	13	49
Colonies	55	49	39	178
Average number per plate	6.8	2.7	3.0	3.6
Colonies per cubic millimeter of air	1,782	707	785	943

We used this method of collecting mold spores in the air at various times of the day, as in the similar study made by Alvarez and Castro¹ in Havana. As shown in Fig. 2 and Table V, the peak average number of colonies per plate was at about 0300 (3:00 A.M.). The counts in Honolulu were much lower and the difference between day and night counts was much less than in Havana.

AVERAGE SPORE COUNTS AT VARIOUS TIMES OF DAY IN HAVANA AND IN HONOLULU

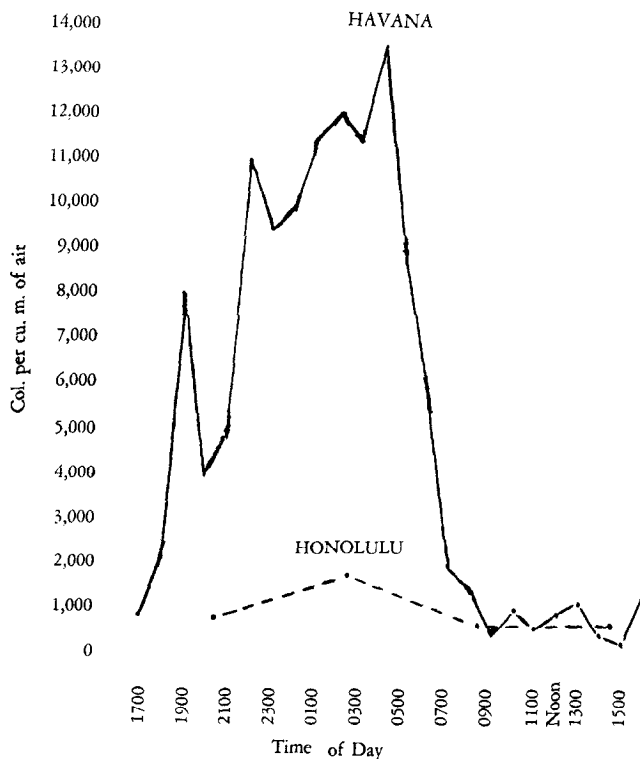


Fig. 2.—A comparison of the average spore counts per cubic meter of air at various times of the day in Havana and Honolulu. This method of sampling minimizes the effect of wind velocity on the mold spore counts.

SUMMARY

1. Mold spore counts in Honolulu are much lower than in most mainland cities.
2. *Hormodendrum* comprises 33 per cent and *Alternaria* less than 1 per cent of the total count.

3. The average monthly plate count does not seem to be correlated with the incidence of asthma in children.

4. Spore counts tend to be higher on windy days than on calm days, in spite of the direction of the wind.

5. A method of minimizing the effect of wind on spore counts by the use of an "air sampler," as described by Alvarez, was found to be fairly satisfactory.

I wish to thank Mr. Kaname Saito and Miss Gertrude Ching, of our laboratory staff, for their help in making this survey possible.

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