

# Some biodeteriorating air-borne fungi in and around Lucknow, India

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## ABSTRACT

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The paper presents the result of qualitative and quantitative analyses of mycoflora in the air of Lucknow city and adjoining areas. Burkard slide sampler and Andersen two-stage volumetric samplers were employed for air sampling at forty places of Lucknow at different times of the year from January 1997 to February 1998. As many as thirty-five types of fungal spores and twenty-nine types of fungal colonies were registered.

It has been envisaged that certain fungi such as *Alternaria*, *Aspergillus*, *Chaetomium*, *Cladosporium*, *Curvularia*, *Diplodia*, *Epicoccum*, *Fusarium*, *Nigrospora*, *Penicillium*, *Rhizopus*, *Torula*, *Trichoderma*, *Trichohaecium*, etc., prevalent in the air are associated with the biodeterioration of cultural properties.

**Key-words**—Air-borne fungi, Biodeterioration. Cultural properties, Lucknow.

भारत अवस्थित लखनऊ तथा इसके आस-पास उपस्थित कुछ जैवअवनतिकारक वायुजात कवक

आशा खण्डेलवाल, रश्मि तिवारी, लिली मिश्र एवं रश्मि सक्सेना

## सारांश

प्रस्तुत शोध पत्र में लखनऊ शहर तथा इससे जुड़े क्षेत्रों के वायुमण्डल में उपस्थित कवक वनस्पतिजात के गुणात्मक तथा मात्रात्मक विश्लेषण के परिणामों की विवेचना की गयी है। इस हेतु जनवरी 1997 से फरवरी 1998 के मध्य के भिन्न-भिन्न कालों में लखनऊ के चालीस स्थानों के वायु नमूने लेने के उद्देश्य से बरकार्ड स्लाइड प्रतिलिपित्र तथा एण्डरसन के दो चरणों वाले आयतनी प्रतिलिपित्र लगाए गए। कवकीय बीजाणुओं के लगभग पैंतीस रूप तथा कवकीय उपनिवेशों के उन्तीस रूप अंकित किए गए।

यह प्रस्तावित किया जाता है कि वायुमण्डल में व्यापक रूप से उपस्थित कुछ कवक जैसे—*आल्टरनेरिया*, *एस्पेर्जिलस*, *कीटोमियम*, *क्लैडोस्पोरियम*, *कर्वूलेरिया*, *डाइप्लोडिया*, *एपिकोकम*, *फ्यूजेरियम*, *नाइग्रोस्पोरा*, *पेनिसिलियम*, *राइज़ोपस*, *टोर्यूला*, *ट्राइकोडर्मा*, *ट्राइकोथीशियम*, इत्यादि सांस्कृतिक सम्पत्तियों के जैवअवनतिकरण से सम्बद्ध हैं।

**संकेत शब्द**—वायुजात कवक, जैवअवनतिकरण, सांस्कृतिक सम्पत्तियाँ, लखनऊ।

## INTRODUCTION

THE district of Lucknow (26°30'-27°10' N and 80°30'-81°13'E) is an irregular, quadrilateral area located in the Gangetic plain of Uttar Pradesh. The climate is characteristically periodic with three well-marked seasons and sub-tropical monsoon type of climate. The flora of this district has changed dramatically over the recent years.

The valuable articles such as manuscripts, books, wall hangings, wood articles, paper crafts and various types of paintings of museums, archives, libraries, etc. get deteriorated due to the attack of different kinds of micro-organisms. This problem is more detrimental in tropical humid climate like India and can be solved to a large extent by estimating the qualitative and quantitative measures of causal organisms in the ambient air followed by suitable control measures. The present study was aimed to determine the correlation of air-borne fungal spores present in different parts of Lucknow and their impact on the properties of cultural heritage.

## MATERIAL AND METHODS

The sampling was carried out by two internationally recognised air samplers provided under MEF sponsored project entitled "Aeroallergens and human health: aerobiological studies". These volumetric air samplers are usually employed for aerobiological studies where both qualitative and quantitative estimates of aeromycoflora are required and precise identifications are the prerequisites.

The air samples were collected from forty different places of Lucknow city and suburbs at different times of the year from January 1997 to February 1998 employing both the samplers simultaneously. The slides smeared with safranin-stained glycerine jelly were exposed for 10 min in Burkard slide sampler for identification and estimation of dispersed air-borne fungal spores. It is battery/power operated volumetric sampler, which sucks air at the rate of 10 litres/min. The rectangular cover slips (22 x 50 mm) were used and data was calculated in terms of fungal spores/sq cm of the slide surface.

The petridishes with sabourand's nutrient agar medium were exposed for 10 min time in Andersen two-stage sampler simultaneously with a visual identification method for specific identification of culturable fungi. After recording the data, the average colony concentration was converted into per metric cube of air by using recommended conversion factor. The data generated on these samplers provide specific number and frequency of fungal spores/colonies in a given volume of air, thus increasing the importance of data to be readily used as a prerequisite for aeropalynological studies in general and indoor aeromycological studies in particular.

## RESULTS

The qualitative and quantitative analyses of aeromycoflora of forty different places of Lucknow are quite variable. The petridishes exposed in Andersen air sampler recorded the highest colony counts from Kanpur Road followed by Chinhat, Sitapur Road, Lucknow University, Sarojini Nagar, Talkatora Road, Charbagh, Hardoi Road, Bani, River Bank Colony, etc (Fig. 1). Amongst the twenty-nine types of fungal colonies recorded from all the sites, *Cladosporium cladosporioides* was dominant and *Alternaria alternata* was subdominant. It was followed by *Mucor hiemalis*, *Fusarium oxysporum*, *Penicillium funiculosum*, *Aspergillus niger*, *Curvularia lunata*, *Helminthosporium* sp., *Penicillium citrinum*, *Aspergillus flavus*, *A. nidulans*, etc.

The composition of dispersed fungal spore obtained on the slides by Burkard sampler was quite different. The site of maximum occurrence of fungal spores was different from that of fungal colonies. The maximum fungal spores were recorded from Sitapur Road followed by Hardoi Road, Sugarcane Research Institute, Residency, Charbagh, Malihabad, CIMAP, Jankipuram, Sardar Patel Marg, etc. (Fig. 2). The spores of *Cladosporium* were dominant as was the case in registration of fungal colonies. The small round spores ranked second followed by *Alternaria*, *Curvularia*, *Epicoccum*, *Helminthosporium*, *Drechslera*, *Periconia*, *Torula*, *Chaetomium*, etc.

## DISCUSSION AND CONCLUSIONS

Fungi are ubiquitous and have wide range of genera and species. The earlier aeromycological studies carried out in Lucknow either in Birbal Sahni Institute of Palaeobotany or elsewhere in Lucknow only provided the qualitative estimates of aerobiota. But in the present study both qualitative and quantitative data was obtained by employing the technologically advanced air-samplers.

The botanical specimens, manuscripts, books, wall hangings, wood/paper crafts and various other material of cultural heritage provide an ideal substrates for the growth and proliferation of several fungi and probably in most of the cases they get liberated in the ambient air. In enclosed spaces, the bindery glues, old paper dust, binding fabrics and humidity due to coolers deteriorate the situation manifold. Several species of *Aspergillus*, *Fusarium*, *Penicillium*, *Alternaria*, *Trichoderma*, *Cladosporium*, etc. are found growing on herbarium and other dry preserved materials of National Museum of Natural History, New Delhi (Nair, 1971).

The aerobiological studies in the indoor air of library was conducted by Tilak and Vishwe (1976) recording the presence of air-borne spores of *Aspergillus*, *Cladosporium*, *Torula*, *Penicillium*, *Trichoderma* and *Chaetomium*. Many cellulose

decomposing fungi such as *Alternaria*, *Monilia*, *Fusarium*, *Chaetomium*, *Myrothecium*, *Torula*, *Stachybotrys*, *Cladosporium*, *Paecilomyces*, *Rhizopus* and *Epicoccum* were also reported from a library of Aurangabad (Tilak & Saibaba, 1984). The high prevalence of *Cladosporium*, *Penicillium* and *Alternaria* inside libraries are also reported by Tripathi (1987), Tilak and Pillai (1988) and Singh *et al.*, (1990). Species of *Aspergillus*, *Penicillium* and *Cladosporium* were in great abundance in the indoor air of library of Madras University (Nadimuthu & Vittal, 1995). The agitation of books causes marked increase in the concentration of fungal spores (Burge *et al.*, 1978; Singh *et al.*, 1990; Vittal & Glory, 1985).

*Alternaria alternata*, *Aspergillus sydowii*, *A. niger*, *Cladosporium cladosporioides*, *Penicillium citrinum* were found occurring on different cellulosic materials such as manuscript and books, wood craft, paintings, wall hangings, etc. in Gorakhpur (Lakshmikant & Mathur, 1989). *Aspergillus flavus*, *A. nidulans*, *A. niger*, *A. sydowii*, *A. terreus*, *A. ustus*, *A. versicolor*, *Alternaria*, *Chaetomium*, *Cladosporium*, *Diplodia*, *Epicoccum*, *Fusarium*, *Paecilomyces varioti*, *Penicillium citrinum*, *Rhizopus*, *Torula*, *Trichoderma*, *Trichothecium*, etc. recorded in the present study, have been identified for the considerable damage of miniature paper paintings and lithographs by Dhawan and Agarwal (1986). Most of the fungi encountered in the present survey are generally similar to those found in indoor environment. The outdoor fungal spores get easy access in indoor air through open doors and windows and on getting optimum environmental conditions and proper substrates they start growing and proliferating. The air-monitoring inside the Ajanta and Ellora caves (Tilak *et al.*, 1972) and in Aurangabad (Tilak & Kulkarni, 1972) has established a correlation between air borne micro-organisms and environmental conditions that led to the biodeterioration of wall paintings of Ajanta and sculptures of Ellora. Thus, from the study of aerial survey it may be concluded that fungal spores suspended in the air must be traced back to their sources to which much attention has not been paid by the scientist so far. Hence, studies on biodeterioration aspects of conservation of cultural properties need to be expanded and strengthened in order to save the

cultural heritage. The role of micro-organisms in causation of allergic rhinitis and bronchial asthma from library dust is well documented and should also be properly assessed in indoor environments.

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Locality	Rae Buzaji Rd. (10 km)	Rae Asbbagh Residency	River Bank Colony	Kampur Charbagh (15 km)	Nirala Hardoi Rd. Nagar (15 km)	Art's Musabagh College	River Bank Colony	Sardar Patel Marg	CIMAP	Ring Road	Jauhi -puram	Sitapur Rd. (10 km)	Rail Nagar	SCFPI	Sarojini Nagar	Mohanlal Ganj				
Date of collection	3-1-97	22-1-97	24-1-97	4-2-97	18-2-97	21-2-97	4-3-97	6-3-97	21-3-97	4-4-97	15-4-97	22-4-97	9-5-97	9-5-97	14-5-97	13-6-97	16-6-97	23-6-97	9-7-97	11-7-97
S.N. Name of fungal spores	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
<i>Aspergillus candidus</i>																				
<i>A. flavus</i>																				
<i>A. nidulans</i>																				
<i>A. niger</i>																				
<i>A. carneus</i>																				
<i>A. fumigatus</i>																				
<i>A. sydowii</i>																				
<i>A. terreus</i>																				
<i>A. versicolor</i>																				
<i>A. sulphureus</i>																				
<i>A. tamaritii</i>																				
<i>Alternaria alternata</i>																				
<i>Curvularia lunata</i>																				
<i>C. tetramera</i>																				
<i>Chaetomium globosum</i>																				
<i>Cladosporium cladosporioides</i>																				
<i>Emericella nidulans</i>																				
<i>Fusarium roseum</i>																				
<i>F. oxysporum</i>																				
<i>Helminthosporium sp.</i>																				
<i>Monilia sitophila</i>																				
<i>Mucor hiemalis</i>																				
<i>Penicillium funiculosum</i>																				
<i>P. citrinum</i>																				
<i>Rhizoctonia sp.</i>																				
<i>Rhizopus stolonifer</i>																				
<i>Trichoderma lignorum</i>																				
<i>Trichothecium roseum</i>																				
Unidentified fungal colonies																				
<b>Total</b>	<b>31</b>	<b>18</b>	<b>19</b>	<b>45</b>	<b>66</b>	<b>45</b>	<b>42</b>	<b>46</b>	<b>32</b>	<b>38</b>	<b>42</b>	<b>38</b>	<b>34</b>	<b>41</b>	<b>25</b>	<b>49</b>	<b>16</b>	<b>30</b>	<b>48</b>	<b>37</b>

Continued...

S.N.	Name of fungal spores	Jail Road		HAL Colony Rd. (15 km)		Kampur Colony Rd. (15 km)		Chubhat Barabanki Rd. (15 km)		Jhanda Malhabad Park		Bani Lucknow University		Talkatora Road		Sitapur Rd. (10 km)		Kampur Rd. (12 km)		Hardoi Rd. (15 km)		Mohan Sugarcane Marg Institute		Carrappa Road		Ashiana Colony		Hardoi Rae Bareilly Rd. (14 km)		Sitapur Rd. (13 km)		Total
		25-7-97	1-8-97	19-8-97	1-9-97	3-9-97	4-9-97	6-10-97	16-10-97	20-10-97	4-11-97	12-11-97	13-11-97	15-12-97	17-12-97	19-12-97	9-1-98	20-1-98	6-2-98	9-2-98												
1	<i>Aspergillus candidus</i>		2	2	6	1	3	2	5	3	3	5	2	2	1	1	2	5	2	2	1	1	2	2	1	1	2	47				
2	<i>A. flavus</i>	1	4	1	2	7	2	2	3	2	2	3	2	3	2	2	1	3	2	2	2	2	1	2	2	1	1	64				
3	<i>A. nidulans</i>		1	2	1	6	2	2	1	2	1	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	2	58				
4	<i>A. niger</i>	1	3	5	3	3	6	10	2	7	6	1	3	2	2	1	3	2	3	2	1	1	2	2	1	1	1	92				
5	<i>A. carneus</i>	2																											2			
6	<i>A. fumigatus</i>		2	1	2	3			4	3	2	2	4	3	2	2	2	2	4	3	2	1	1	2	1	1	1	28				
7	<i>A. sydowii</i>								1																				2			
8	<i>A. terreus</i>	1	1	1	1	2	2	2	2	2	3	2	2	2	3	1	4	4	4	4	2	2	1	2	2	2	2	46				
9	<i>A. versicolor</i>								1																				9			
10	<i>A. sulphureus</i>								1																				12			
11	<i>A. tamarii</i>	2	2	4			1																						27			
12	<i>Alternaria alternata</i>	5	3	4	2	2	3	4	3	6	2	2	3	6	2	2	2	3	1	2	1	2	1	2	1	2	2	117				
13	<i>Curvularia lunata</i>	3	3	4	3	4	3	2	3	2	2	2	3	2	2	3	1	5	1	2	3	1	2	3	1	1	1	89				
14	<i>C. tetramera</i>					1	5	2							2	1	2	2	2	2	2	2	2	2	2	1	2	54				
15	<i>Chaetomium globosum</i>																												6			
16	<i>Cladosporium cladosporioides</i>	2	6	8					3	6	5	1	2	2	2	2	2	2	2	2	1	2	2	2	2	1	1	140				
17	<i>Emicella nidulans</i>																												5			
18	<i>Fusarium roseum</i>	5	2						3	1	1	1	1	1	1	3	1	3	1	1	1	1	1	1	1	1	1	49				
19	<i>F. oxysporum</i>	2	3	1	2	4	6	3	4	3	3	2	2	2	2	2	2	2	2	2	2	2	2	4	2	1	1	99				
20	<i>Helminthosporium sp.</i>	1	2	9					1	1	1	3	4	1	3	4	1	3	1	2	1	2	2	1	3	1	1	77				
21	<i>Monilia sitophila</i>																												1			
22	<i>Mucor hiemalis</i>	1	6	3	5	4			4	4	3	2	5	3	2	1	3	2	5	3	2	1	3	1	3	1	1	99				
23	<i>Penicillium funiculosum</i>	2	2			10	2		3	7	3	4	1	4	1	2	2	4	1	4	1	2	1	2	1	1	1	94				
24	<i>P. citrinum</i>	2							2	2	2	6	1	2	6	1	2	9	2	9	2	1	1	1	1	1	1	68				
25	<i>Rhizoctonia sp.</i>	1																											2			
26	<i>Rhizopus stolonifer</i>	2	5	1	3				3	4			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	28				
27	<i>Trichoderma lignorum</i>																												27			
29	<i>Trichothecium roseum</i>	2							1	1	3	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	14				
30	Unidentified fungal colonies								1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	8				
<b>Total</b>		<b>35</b>	<b>39</b>	<b>39</b>	<b>53</b>	<b>43</b>	<b>37</b>	<b>43</b>	<b>44</b>	<b>50</b>	<b>46</b>	<b>23</b>	<b>41</b>	<b>27</b>	<b>11</b>	<b>18</b>	<b>23</b>	<b>8</b>	<b>11</b>	<b>13</b>	<b>13</b>	<b>18</b>	<b>18</b>	<b>23</b>	<b>8</b>	<b>11</b>	<b>13</b>	<b>18</b>	<b>1364</b>			

Fig. 1—Number of fungal species (CFU/m<sup>3</sup>) during sampling period (Andersen two-shape sampler).

Locality	Rae Bareilly Rd. (10 km)	Aishbagh Residency	River Bank Rd. (15 km) Colony	Kampur Charbagh	Nirala Handoi Rd. Nagar (15 km)	Art's College	Musabgh	River Bank Colony	Sardar Patel Marg	CIMAP	Ring Road	Janki -puram	Stapur Rd. (10 km)	Rail Nagar	SGPGI	Sarojini Nagar	Mohamml Ganj			
Date of collection	3-1-97	22-1-97	24-1-97	4-2-97	18-2-97	21-2-97	4-3-97	6-3-97	21-3-97	4-4-97	15-4-97	22-4-97	9-5-97	9-5-97	14-5-97	13-6-97	16-6-97	23-6-97	9-7-97	11-7-97
S.N. Name of fungal spores	1	2	7	5	3	13	2	6	5	6	7	8	15	7	7	50	10	14	8	3
<i>Alternaria</i> sp.	1	2	7	5	3	13	2	6	5	6	7	8	15	7	7	50	10	14	8	3
<i>Bispora</i> sp.	1	3	2	2	2	6	1	1	2	2	1	3	2	2						1
<i>Beltrania</i> sp.		2	1	1																
<i>Cercospora</i> sp.																7	8	4		1
<i>Chaetomium</i> sp.	6	13	17	14	13	14	8	15	7	10	10	10	20	20	27	3	4	8	10	7
<i>Gladosporium</i> sp.	4	2	6	2	1	4	1	2	3	5	7	4	8	4	1	4	1		7	
<i>Curvularia</i> sp.																				
<i>Dictyosporium</i> sp.																				
<i>Didymosphaeria</i> sp.																				
<i>Drechslera</i> sp.	2	2	3	1	3	1	6	4	1	2	1	2	2	2	2	2	2		1	
<i>Epicoccum</i> sp.	1	2	27	7	2	11	2	2	4	2	2	7	9	4	1	4				
<i>Exosporium</i> sp.																				
<i>Fusarium</i> sp.	4	1	3	4	10				2											
<i>Fusarium</i> sp.																				
<i>Ganoderma</i> sp.	2	2	3	3	4	9	4	4	4	3	10	3	10	3	3	5	1	6		2
<i>Helminthosporium</i> sp.																				
<i>Heterosporium</i> sp.																				
<i>Leptosphaeria</i> sp.																				
<i>Lophiostoma</i> sp.																				
<i>Myrothecium</i> sp.																				
<i>Nigrospora</i> sp.	1	2	12	3	1	6	1	9	1	2	1	1	3	1	2	2	1		1	
<i>Periconia</i> sp.	2																			
<i>Pithomyces</i> sp.																				
<i>Pleospora</i> sp.	1	2	2	1	1	1	1	1	8	2	2	3							1	
<i>Sordaria</i> sp.																				
<i>Spegazzinia</i> sp.																				
<i>Sporidesmium</i> sp.	1	7	7	2	2	4	4	2	1	1	2	2	1		2					
<i>Teichospora</i> sp.																				
<i>Tetraploa</i> sp.	3	2	2	1	3	1	2	2	2											
<i>Torula</i> sp.																				
<i>Trichothecium</i> sp.																				
2-4 celled spores																				
Round spores																				
Uredo. of <i>Puccinia</i>	2	2	7	4	2	1	1	1	1	2	6	8	15	6	7	2	5			
Smut spores																				
Unidentified spores	8	9	1	9	14	4	13													
<b>TOTAL</b>	<b>41</b>	<b>42</b>	<b>98</b>	<b>55</b>	<b>56</b>	<b>91</b>	<b>54</b>	<b>60</b>	<b>45</b>	<b>35</b>	<b>46</b>	<b>65</b>	<b>81</b>	<b>48</b>	<b>72</b>	<b>109</b>	<b>35</b>	<b>44</b>	<b>27</b>	<b>25</b>

Continued...

Locality	Jail Road	HAL Colony Rd (15 km)	Kanpur Chintah Barabanku Rd. (15 km)	Jhanda Mithabadi Wala Park	Ban Lucknow University	Talkatora Road	Stapur Rd (10 km)	Kanpur Rd (12 km)	Hindoi Rd. (15 km)	Mohaan Sugarcane Mang. Institute	Catappa Road	Ashiana Colony	Hardoi Rae Barahi Rd. (14 km)	Sitapur Rd. (13 km)	Total		
Date of collection	25-7-97	1-8-97	19-8-97	3-9-97	6-10-97	20-10-97	4-11-97	12-11-97	13-11-97	15-12-97	17-12-97	19-12-97	9-1-98	20-1-98	6-2-98	9-2-98	
S.N. Name of fungal spores																	
1 <i>Alternaria</i> sp.		2	2	6	3	10	26	1	1	13	1	2	3	4	1	1	273
2 <i>Bispora</i> sp.			2	1	1	1	2	4	1	3	1	2	8	2			60
3 <i>Beltrania</i> sp.																	4
4 <i>Cercospora</i> sp.	2		2	4	3	5	6	1	5	2	2	1	2	2			65
5 <i>Chaetomium</i> sp.		2	3	2	1	2	7	3	2	3	2	1	1	1		2	67
6 <i>Cladosporium</i> sp.	3	4	8	6	2	6	6	8	7	18	6	4	9	19	6	17	385
7 <i>Curvularia</i> sp.		6	1	1	10	10	3	1	1	4	2	7	1	1	2	3	121
8 <i>Dictyosporium</i> sp.																	2
9 <i>Didymosphaeria</i> sp.					4												4
10 <i>Drechslera</i> sp.		2	2	1	1	4	1	2	4	5	14	1	2	1	3	84	
11 <i>Epicoccum</i> sp.	2	1						2	1	3	3	1	2	3	4	111	
12 <i>Exosporium</i> sp.			2				1									7	
13 <i>Fusariella</i> sp.																	2
14 <i>Fusarium</i> sp.			2	3	2	3	2	1	2	6	2	8	2	2	2	58	
15 <i>Ganoderma</i> sp.		2						1									6
16 <i>Helminthosporium</i> sp.		2	7	2	7	10	2	1	2	2	2	2	1	1	2	110	
17 <i>Heterosporium</i> sp.								2			1						8
18 <i>Leptosphaeria</i> sp.			1				2										20
19 <i>Lophiostoma</i> sp.								1									1
20 <i>Myrothecium</i> sp.											7						13
21 <i>Nigrospora</i> sp.	1	1	2	1	2	1	2	1	3	2	3	2	1	1	3	1	52
22 <i>Periconia</i> sp.		1	1	2	2	1	1	3	2	8	2	4	3	1	1	4	78
23 <i>Pithomyces</i> sp.								1	1	1	3	1					10
24 <i>Pleospora</i> sp.											4						23
25 <i>Sordaria</i> sp.								2			2						5
26 <i>Spegazzinia</i> sp.											2						2
27 <i>Sporidesmium</i> sp.		2		1	1	2	2				1				7		43
28 <i>Teichospora</i> sp.																	4
29 <i>Tetraploa</i> sp.																	4
30 <i>Torula</i> sp.				1	2	2	1	3	2	7	1	5	7	1	21	1	70
31 <i>Trichothecium</i> sp.											1						8
32 2-4 celled spores	5	1		4													34
33 Round spores	4	4	11	4	8	2	4	6	14	13	12	8	26	11	11	15	283
34 Uredo. of <i>Puccinia</i>	1							1	2	1					1	2	47
35 Smut spores				6													6
36 Unidentified spores	1	1						2			1				2	1	70
<b>TOTAL</b>	<b>17</b>	<b>25</b>	<b>39</b>	<b>35</b>	<b>44</b>	<b>44</b>	<b>83</b>	<b>38</b>	<b>47</b>	<b>105</b>	<b>34</b>	<b>102</b>	<b>46</b>	<b>38</b>	<b>63</b>	<b>37</b>	<b>2140</b>

Fig. 2.—Number of fungal spores (No./m<sup>3</sup>) during sampling period (Burkard Slide Sampler).