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# Occurrence of Anemophilous Fungi in the Special Collection of the Agricultural Sciences Center Library of the Federal University of Paraíba

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### ABSTRACT

**Objectives:** The work objective was to verify the occurrence of anemophilous fungi present in the air and on the surface of books in the special and rare collection of the CCA/UFPB Library. To the isolation of anemophilous fungi present in the air, there used a direct exposure method, in which plates were exposed for 20 min. **Methods:** To the isolation of anemophilous fungi present in the air, there used a direct exposure method, in which plates were exposed for 20 min. The fungi collection from the surfaces of the books, it was performed through rubbing sterile swabs along the entire length of the cover and placed in a test tube with a saline solution. Then, it sowed the samples in Petri dishes containing culture medium. The plates with samples of fungi from the air and the surface of the books, it was incubated in an oven at 28 °C. After the growth of the colonies, the identification was based on macro and micromorphological analyzes. **Results:** There obtained a total of 688 isolates of anemophilous fungi belonging to 14 taxa. Most belong to the group of asexual fungi. The most frequent taxa were *Penicillium* (61.5%), sterile mycelia (23.5%), and *Cladosporium* (7.6%). **Conclusion:** The Library presented an important presence of several fungal genera in its spaces, favoring the biodeterioration of historical documents, besides being able to compromise the health of employees and visitors.

**Keywords:** Atmospheric air, surface of books, allergens.

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## INTRODUCTION

Works of greater relevance to the history of a country, region, or locality are systematized in special and rare collections, in libraries, archives, and museums, in order to maintain their conservation and durability [1]. The general collection in a library, as well as the special collections, requires care to avoid deterioration, which can often be irreversible [2,3]. Fungi are one of the main biological agents responsible for the biodeterioration of documentary collections in libraries [2] since books have a lot of organic matter, the main component of which is cellulose, and also found in the manufacture of the same starch glue, cloth, and leather [4].

Such fungi are known as anemophilous, that is, they have the ability to spread through the air, and are also potential bioallergenic agents responsible for the manifestation of various respiratory pathologies [asthma, rhinitis, and etc.], conjunctivitis, and mycoses [3,5]. Research has shown that anemophilous fungi can harm the health of employees who work in library environments, as well as people who visit, causing several adverse physiological reactions [6]. Besides, they can cause and characterize the Sick Buildings Syndrome, with the manifestation of several symptoms, from eye irritation, fatigue, fever, wheezing, among others; and that has caused problems in the field of occupational health [6, 7, 8].

The special collections of documents from the Sectorial Library of the Agricultural Sciences Center of the Federal University of Paraíba are full of rare works, such as documents and books from the 19th, 20th, and 21st centuries. They tell the story of the first lay higher education institution in the State of Paraíba, former School of Agronomy in the Northeast, with buildings listed by IPHAN as Cultural Heritage of Brazil. Due to its great historical and cultural value, the collection is intensely visited throughout the year by students, researchers, and tourists from Brazil and the world. However, during the execution of an extension project for the

organization and cleaning of documents, strong signs of fungal contamination were detected.

In view of this scenario, knowing the greater damage that such microorganisms cause to documentary collections and also to public health, the present work aimed to verify the occurrence of anemophilous fungi present in the air and on the surface of books from the special and rare collection of the referred library.

## METHODS

The Francisco Tancredo Torres Sectorial Library, CCA/UFPB, is located in the municipality of Areia, Paraíba. The study site is inserted in a fragment of Atlantic Forest, with an altitude of 600 meters above sea level, and has a high rainfall index during the year<sup>[8]</sup>. The library consists of two floors: the ground floor, which houses the general collection, and the basement, where are the administration rooms, receiving books, study, and the special and rare collection. This is housed in two closed rooms, identified as 01 and 02, without air conditioning and with restricted access.

To isolate anemophilous fungi in the air and on the surface of books, it used Potato Dextrose Agar [PDA] culture medium supplemented with cane rose. There used the method of direct exposure for a limited time to collect fungi from the air. In each of the investigated rooms, there exposed four plates for 20 min at a minimum distance of approximately one meter from the floor, making a total of 8 plates. The collection of fungi from the surfaces of the books was performed by rubbing sterile swabs with zigzag movements across the outer area of the cover. Then, there placed the swabs in a test tube containing sterile saline at 0.85%. Five books were selected in each of the rooms, totaling 10 samples. After the samples were collected in the library, they were transported to the Microbiology Laboratory of the Department of Biological Sciences CCA-UFPB.

## RESULTS

A total of 688 isolates of anemophilous fungi, which belong to 14 taxa, were obtained from the

surfaces of books and the atmospheric air of rooms 01 and 02 from the special and rare collection of the Library of the CCA/UFPB. Room 01 showed higher richness [12] and less abundance [281] of anemophilous fungi when compared to room 02. Considering the richness and abundance of the collection sites, book

surface, or atmospheric air, there was a variation between both rooms [Table 1]. There shown in table 2, the composition of the fungi communities, and the majority belonged to the group of non-dematiaceous asexual fungi. The most frequent taxa were *Penicillium*, sterile mycelia, and *Cladosporium* [Table 2].

**Table 1.** Richness and abundance of anemophilous fungi present on the surfaces of books and in the atmospheric air of the rooms from the special and rare collection of the CCA-UFPB Library.

Room	Richness			Abundance		
	Book surface	Atmospheric air	Total	Book surface	Atmospheric air	Total
Room 01	8	9	12	186	95	281
Room 02	7	8	9	194	213	407

**Table 2.** Anemophilous fungi present on the surfaces of books and in the atmospheric air of the rooms from the special and rare collection of the CCA-UFPB Library.

TAXA	ROOM 01		ROOM 02		FREQUENCY %
	Book surface	Atmospheric air	Book surface	Atmospheric air	
<i>Acremonium</i> spp.	0	1	0	8	1,2
<i>Ascotrica</i> sp.	2	0	0	0	0,2
<i>Aspergillus</i> spp.	4	2	4	0	1,4
<i>Basidiomycota</i> sp.	3	0	2	1	0,8
<i>Cladosporium</i> spp.	14	3	23	13	7,6
<i>Fusarium</i> spp.	2	1	0	0	0,4
Hifomiceto spp.	0	0	2	1	0,4
<i>Myrothecium</i> sp.	0	1	0	0	0,1
<i>Paecylomices</i> sp.	1	0	0	0	1,1
<i>Penicillium</i> spp.	88	33	140	163	61,5
<i>Pestalotiopsis</i> sp.	0	5	0	0	0,7
<i>Phomopsis</i> sp.	0	1	0	4	0,7
<i>Xylaria</i> sp.	0	0	2	1	0,4
Sterile mycelia	72	48	21	22	23,5

## DISCUSSION

Anemophilic fungi are the main constituents of air, especially in environments with low air circulation [7]. Like their spores and other propagules, they are easily transported in the atmosphere, mixed with dust, and deposited on the surface of various objects in libraries [11]. The vast majority is represented by species of fungi with dry sporulation, which facilitates their dispersion and dissemination in the environment, and when in favorable conditions of temperature, humidity, and availability of nutrients, they grow and reproduce [3,12]. The rooms that house the special and rare collection of the CCA/UFPB Library, they provide adequate conditions for the existence of an abundant and rich community of anemophilous fungi such as high temperature and humidity, low air circulation, and lack of light. Besides, the existence of a variety of organic materials such as paper fibers, wood, leather, fabric, glue, and among others. The presence of fungi in library environments can compromise the health of employees and visitors, besides being related to the deterioration of books and documents [3].

In our findings, there were present fungi that belong to the phyla Basidiomycota and Ascomycota, besides asexual fungi [10,13]. Most of the isolated fungi have also been reported in other studies as anemophilous fungi, beyond causing allergies in humans such as *Acremonium*, *Aspergillus*, *Cladosporium*, *Fusarium*, *Penicillium*, *Paecylomyces*, and *Myrothecium*. The genera *Aspergillus*, *Fusarium*, and *Penicillium*, besides being allergens, they can cause infectious respiratory disease, depending on the amount inhaled and the host's immune status [14]. The other isolated genera in the present work, such as *Xylaria*, *Pestalotiopsis*, *Phomopsis*, and *Ascotrica*, besides the Phylum Basidiomycota, are not mentioned in many collections conservation manuals [2] either in studies on the diversity of anemophilous fungi [10,14] or in studies on the risks that cause human health [5]. Many species of these genera are associated with plant

substrates acting in the process of decomposition and nutrient cycling. It is known that the diversity of these fungi depends on local climatic factors [7], and the region around the library consists of a fragment of the moist forest with considerable diversity of plants.

Fungi classified as sterile mycelia were frequent in the present study, but due to the non-development of reproductive structures, their identification by formal taxonomy is not possible. Other studies have recorded a high frequency of this group of fungi as anemophilous from different indoor environments [14,16,17]. Among the various fungi found as anemophilous, the literature reports the importance of five genera as triggers for respiratory allergies worldwide, namely: *Alternaria*, *Aspergillus*, *Cladosporium*, *Dreschlera*, and *Penicillium* [18]. In the present work, three of these genera were found. The *Aspergillus* genus is reported as one of the most frequent and abundant fungi in several studies [3,4,14], not corroborating our result. This fungus is widely distributed in the environment and produces very small spores that facilitate long stay in the air. When inhaled, they can cause opportunistic pulmonary infections [aspergillosis] depending on the host's immune system, but they can also attack auditory channels, nasal sinuses, and corneas. Also, they provide onychomycosis, becoming potential pathogens in library environments [19,20].

The genus *Cladosporium*, also with wide distribution, is mainly associated with plants and soil and is expected to commonly colonize substrates containing cellulose fibers, such as books and documents [3]. Spores of several species of this genus are commonly found in the air. Although *Cladosporium* species are rare as pathogens in humans, they can cause skin infections, phaeohyphomycosis, and lung infections [7]. The *Penicillium* fungus was the most abundant as an anemophilous fungus present in both rooms and the different research sites. It is the etiologic agent of penicilliosis, another opportunistic mycosis. The inhalation of

their spores can be fatal to immunosuppressed individuals, since pulmonary involvement and invasion of blood vessels occur, leading to infection of the kidneys and endocardium<sup>[19]</sup>, but cases of contagion are not very common.

## CONCLUSION

The results showed that the special and rare collection of the CCA / UFPB Library had an important presence and colonization of several fungal genera in their spaces. This scenario can cause health risks for employees and visitors to collections, promoting allergic processes, and even opportunistic infections. Another aggravating is related to equity damages since the materials in the collection are exposed to strong biodeterioration processes. It is necessary to take actions that minimize the presence of these fungi to avoid such problems, such as disinfection and improving the conditions of the rooms.

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