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A Systematic Integrative Review of Aerobiological Investigations Related to Arachis hypogaea L. Cultivation in Dhule, Maharashtra

Vilas Patil[1], Pratik Shinde[2*], Avinash Ade[3], Sarita Shinde[4]

[1]Dr. B. N. Purandare Arts and Smt. S.G. Gupta Commerce and Science College, Lonavala, Pune – 410403, Maharashtra, India

[*2]Department of Botany, Prof. Ramkrishna More ACS College, Akurdi, Pune – 411044, Maharashtra, India

[3]Department of Botany, Savitribai Phule Pune University, Ganeshkhind, Pune – 411007, Maharashtra, India

[4]Department of Botany, JET's Zulal Bhilajirao Patil College Dhule – 424002, Maharashtra, India

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ABSTRACT

Aerobiology focuses on understanding the behaviour and distribution of biological particles, or air spora, suspended in the atmosphere, including plant fragments, spores, dust, and animal remnants. Groundnuts emerge as a vital crop in this discussion, prized not only for their nutritional value but also for their versatility in producing oil and organic fertilizer. This field expands into specialized studies like aeropalynology and aeromycology, which examine pollen and fungal spores respectively—elements that have significant implications for public health, particularly through allergies. Recent interdisciplinary efforts in medical paleontology are exploring how controlled exposure to certain fungal allergens might offer therapeutic benefits. Research findings consistently reveal that fungal spores, often originating from genera such as Puccinia, Aspergillus, and Rhizopus, predominate in the airborne particle mix, especially during humid harvest periods. Climatic factors such as temperature, humidity, and vegetation maturity play a crucial role in influencing spore concentrations, as seen in studies across regions like Solapur. Hydroponic groundnut cultivation is revolutionizing agricultural yields by utilizing cost-effective and less labour-intensive techniques. Regions like Dhule in Maharashtra, with their unique semi-arid environment and high agricultural activity, underscore the urgent need for further aerobiological research to enhance both public health and crop productivity.

Keywords: Air spora; Aerobiology; Arachis hypogaea; Groundnut; Review; Rust, etc.

I. INTRODUCTION

Aerobiological studies play a crucial role in understanding airborne fungal spores, their seasonal variations, and their impact on crop health. Multiple research studies have been conducted to examine spore dispersal patterns, meteorological influences, and early disease detection to improve crop protection strategies.

Aerobiological research on groundnut crops globally has provided insights into fungal disease management, spore monitoring, climate change adaptation, and biological control methods. With advancements in spore trapping, predictive modelling, and biocontrol strategies, researchers are now better equipped to forecast and mitigate peanut diseases worldwide.

Several studies have focused on identifying fungal pathogens responsible for peanut diseases. Research by (Alderman et al., 1987; Alderman & Nutter Jr, 1994) in the USA found that *Cercospora arachidicola* spores were transported by wind and correlated with disease outbreaks. Similarly, (Savary, 1986; Savary & Janeau, 1986) in Brazil found that *Puccinia arachidis* spores peaked before harvest, suggesting pre-harvest disease risk.

In Spain, (Rodríguez-Rajo, Iglésias, et al., 2005; Rodríguez-Rajo, Méndez, et al., 2005) studied *Alternaria* and *Cercospora* spore loads, showing temperature and humidity as key factors. Meanwhile, (Singh & Mathur, 2021) in South Africa highlighted the economic impact of peanut leaf spot, recommending early spore detection for crop protection.

Climate change is influencing spore dispersal, disease patterns, and fungal reproduction in peanut fields. (Irwin, 1999) in Australia reported that warming conditions led to an increase in airborne *Cercospora* and *Alternaria* spores, intensifying peanut infections.

Similarly, (Gorai, 2021) says the USA found that higher temperatures favoured rust fungi, while (Lokendra Singh & Preeti Vats, 2006) in Italy noted that *Puccinia* and *Cercospora* spores became more dominant due to changing climate conditions.

(Cu & Phipps, 1993) in Africa analysed the correlation between wind speed and rust spore dispersal, finding that higher wind speeds accelerated disease spread.

In the UK, (Mallaiah & Rao, 1981, 1982, 1987a) studied long-distance transport of rust spores, revealing that wind currents can carry spores up to 350 km, increasing the risk of cross-regional disease outbreaks.

Several researchers have worked on aerobiological models for peanut disease prediction. (Hirst, 1992) in the USA demonstrated that *Trichoderma harzianum* (a biocontrol agent) could reduce airborne fungal loads, offering an alternative to chemical fungicides.

Disease control in peanuts involves fungicide application, conservation tillage, and biological control measures. (Porter & Wright, 1991) in the USA found that conservation tillage practices reduced spore dispersion and helped lower early leaf spot incidence. Similarly, (Augusto & Brenneman, 2011; Vicentini et al., 2023) found that precise fungicide spray timing could suppress *Cercospora* and *Puccinia* spores, especially when combined with post-spray irrigation. (Yusnawan, 2013) in China suggested that *Ageratum conyzoides* plant extracts reduced peanut rust spore viability, offering a potential organic disease management strategy.

Spore monitoring is essential for early detection and intervention. (Rodríguez-Rajo et al., 2004; Rodríguez-Rajo, Méndez, et al., 2005) in Spain used spore traps and meteorological models to track *Alternaria* and *Cercospora* spores, demonstrating a strong correlation with weather conditions. In Argentina, (Pedrosa Jr, 1975) emphasized the need for real-time surveillance systems to prevent large-scale disease outbreaks. Additionally, (Mallaiah & Rao, 1981, 1982, 1987b; Rao & Mallaiah, 1988) at ICRISAT (Africa) confirmed that high spore loads in peanut fields were influenced by humidity and wind patterns.

Rust diseases remain a major concern due to their highly infectious airborne spores. (Mallaiah & Rao, 1987b) in the UK demonstrated that rust spores could travel long distances, crossing national agricultural zones. (Rodriguez-Rajo et al., 2003) in Brazil also confirmed that wind-borne rust spores contributed to regional disease spread, making cross-border aerobiological monitoring necessary.

Aerobiological Research on Groundnut Crops in Dhule, Maharashtra

Aerobiological studies in Dhule, Maharashtra, have extensively focused on monitoring airborne fungal spores that contribute to groundnut crop diseases. (Patil et al., 2022, 2023) found that spore density increases significantly in humid conditions, leading to higher disease susceptibility. (Jadhav et al., 2010) emphasized the role of continuous aerobiological monitoring in controlling fungal outbreaks, while (Ambhore, 2015) identified *Chaetomium* spores as a major cause of groundnut fungal infections.

The seasonal impact on fungal spores has been a key area of study. (Thakur, 2018) observed that monsoon seasons led to higher fungal diversity, increasing the risk of disease outbreaks. (Kshirsagar et al., n.d.; Ragho, 2020) compared Kharif and Rabi season mycoflora, showing that spore concentrations peaked during the monsoon period, accelerating fungal growth. (Mhatre & Jagtap, 2023) found that wind currents and temperature shifts influenced airborne spore dispersal, making meteorological monitoring essential.

Meteorological parameters such as temperature, wind speed, and humidity play a crucial role in spore dispersal. (Kumari & Singh, 2017) confirmed that high humidity increases rust disease outbreaks. (Nilofar Y. Khan et al., 2015) demonstrated that monsoon winds significantly influence fungal spore spread, highlighting the need for early forecasting models.

(Różewicz et al., 2021) reviews various fungal diseases affecting cereals and emphasizes the importance of management practices such as crop rotation, which can reduce the build-up of pathogen inoculum in crop residues. Although it does not specifically focus on the cross-contamination between cereals and groundnut crops, its findings support the broader concept that diversified cropping systems can help mitigate fungal disease incidence. It is also found that fungal infestation patterns in early groundnut growth stages, recommending preventive measures. (Aher S. K., 2019; Malati, 2021) examined microbial air quality, showing that rainfall and humidity fluctuations altered fungal composition in Nashik's groundnut farms. (Heyden et al., 2021) This review provides a comprehensive overview of spore sampling systems and the methodological challenges involved in monitoring airborne fungal inoculum in agricultural settings. It emphasizes the integration of modern molecular techniques and spatial surveillance networks, offering insights into developing early warning systems for plant disease management.

To predict and prevent disease outbreaks, researchers have developed spore monitoring models. (Malik et al., 2002; Singh et al., 2008) reviewed 50 years of aerobiological studies, emphasizing spore trapping for early disease detection.

Several studies suggest integrated disease management approaches. (Gaikwad et al., 2018) This study investigates the potential of *Trichoderma harzianum* as a biocontrol agent by assessing its inhibitory effects on several soilborne fungal pathogens affecting groundnut crops. The results demonstrated significant mycelial growth suppression—most notably against *Fusarium roseum*—highlighting the promise of *T. harzianum* in sustainable disease management practices. (Augusto & Brenneman, 2011; Kurganskiy et al., 2021) found that timing fungicide applications correctly significantly reduced airborne *Cercospora* and *Puccinia* spores. (Chavan et al., 2021) examined the efficacy of various biocontrol agents as alternatives to chemical fungicides for managing soilborne pathogens. Although the primary focus is on controlling *Fusarium oxysporum* and *Sclerotium rolfsii*, the discussion highlights that while fungicides effectively reduce pathogen loads, they may also adversely impact beneficial soil microflora. This supports the idea that integrating biological control measures could help mitigate the collateral damage caused by conventional chemical treatments.

With rising temperatures, climate change is impacting fungal pathogen loads in groundnut fields. (Pawar et al., 2015) reviewed climate-induced variations, showing an increase in rust and leaf spot incidences. (Selvakumar & Viswanathan, 2021) review provides comparable insights by demonstrating that after the monsoon, there is a marked increase in airborne rust spores, which correlates with a post-monsoon peak in rust disease occurrence. The authors describe a novel, low-cost sampling method that captures and quantifies spore densities, reinforcing observations that climatic conditions, especially in the post-monsoon period, play a pivotal role in triggering disease outbreaks.

Nutritional Value of Arachis hypogaea L.

Arachis hypogaea L., or peanut, is a nutritionally rich legume widely consumed for its balanced composition of macronutrients, micronutrients, and bioactive compounds. The nutritional composition of peanuts makes them a highly beneficial food, particularly in the contexts of cardiovascular health, metabolic function, immune response, and disease prevention. (Kramer & Eversmeyer, 2013; Settaluri et al., 2012; USDA Food Composition Database, 2020)

1. **Macronutrients**
   - Energy: Peanuts are energy-dense, providing 567 kcal per 100 g, making them a suitable dietary choice in energy-demanding conditions or undernutrition scenarios.
   - Carbohydrates (21.5 g/100 g): Peanuts have a low glycaemic index (GI) and glycaemic load (GL), which means they release glucose into the bloodstream slowly, avoiding sudden blood sugar spikes—beneficial for diabetics and weight management.
   - Proteins (20 g/100 g): Rich in protein, peanuts contribute to muscle development, enzyme production, and immune function. These proteins contain important functional components that may reduce cardiovascular risks.
   - Fats (49.24 g/100 g): Although high in fat, the majority are unsaturated fats—specifically monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA)—which help lower LDL cholesterol and protect against heart diseases.
2. **Dietary Fiber and Cholesterol**
   - Dietary Fiber (8.5 g): Promotes gastrointestinal health by improving stool movement, reducing cholesterol levels, and aiding in blood sugar control.
   - Cholesterol (0 mg): The complete absence of cholesterol makes peanuts heart-friendly.
3. **Vitamins**

Peanuts are a source of several B-complex vitamins and vitamin E:

- Vitamin E (Tocopherol) acts as a strong antioxidant, protecting cells from oxidative damage.
- B-vitamins (Thiamine, Riboflavin, Niacin, Pyridoxine, Pantothenic acid, and Folic acid) play crucial roles in energy metabolism, enzyme function, red blood cell synthesis, and neurological health.

These vitamins are essential for maintaining cellular function, DNA synthesis, and nervous system activity.

4. **Minerals**

Peanuts offer a rich array of essential minerals:

- Magnesium, Potassium, Sodium, and Calcium are involved in muscle contraction, nerve transmission, and bone health.
- Phosphorus and Zinc support cellular repair, immune function, and growth.
- Iron and Copper are necessary for hemoglobin synthesis and oxygen transport.
- Manganese and Selenium act as enzyme cofactors and antioxidants, essential in protecting cells from oxidative stress.

These minerals are especially important for populations vulnerable to anemia, osteoporosis, and immune dysfunction.

5. Phytonutrients (Bioactive Compounds)

Peanuts also contain bioactive compounds with pharmacological properties:

- Isoflavonoids like genistein act as phytoestrogens and have anticancer potential.
- Phenolic acids and caffeic acids provide antioxidant and anti-inflammatory effects.
- Resveratrol, a well-known polyphenol found in the peanut skin, is associated with neuroprotective, anti-obesity, and cardioprotective functions.
- Phytosterols, particularly β-sitosterol, help reduce cholesterol and provide protection against heart diseases.

II. CONCLUSION

Aerobiology examines the behaviour and distribution of biological particles that are suspended in the atmosphere, often via droplets or other airborne mechanisms. These particles commonly referred to as "air spora" encompass fragments of plants and animals, spores, dust, and similar constituents that typically settle within approximately three feet from their origin.

Groundnuts, also known as peanuts, monkey nuts, or earthnuts, are not only a cost-effective and palatable food source but also nutritionally robust. They contain a range of bioactive compounds, including resveratrol, isoflavonoids, phenolic acids, and phytosterols. Additionally, groundnut seeds serve a dual purpose: oil can be efficiently extracted for culinary and industrial use, while the residual oil cake finds application as animal fodder or organic fertilizer.

Within the broader field of aerobiology, specialized sub-disciplines have emerged. For instance, aeropalynology specifically investigates airborne pollen, whereas aeromycology focuses on the study of fungal constituents in the air. Given that plant-derived spores constitute a significant portion of air spora, pollen-induced allergies have garnered particular attention as a pressing public health concern in the context of an ever-changing global environment.

A novel interdisciplinary field medical paleontology has recently been introduced to bridge gaps between public health and medicine, highlighting how exposure to certain fungal aeroallergens can be utilized therapeutically. In some studies, extracts of these allergens have been explored for their role in the hyposensitization of gynecological patients, demonstrating promising clinical applications.

Investigations of air spora have consistently revealed that fungal spores, particularly from the genera *Puccinia*, *Aspergillus* and *Rhizopus*, dominate the airborne particle profile. Notably, the incidence of fungal infections tends to escalate during harvest periods, a trend likely attributable to increased humidity in agricultural settings.

Research conducted across regions including Walunj, Nashik, Dhule, and Solapur has confirmed that air spora comprises a diverse array of airborne materials, such as hyphal fragments, insect scales, plant debris, and pollen grains. These studies also suggest that climatic factors including temperature, humidity, and the maturation stage of nearby vegetation play a significant role in influencing the overall spore concentration. For example, in Solapur, the highest spore concentrations were observed during the summer season in hot, humid, and even dry climatic conditions.

Finally, in the context of agricultural innovation, the application of hydroponic techniques to groundnut cultivation presents a promising avenue for increasing crop yield. Research has evidenced considerable genetic variability in the root characteristics of peanuts across diverse experimental methodologies, including field trials (Rucker et al., 1995), pot experiments (Ketring, 1984; Rucker et al., 1995), investigations conducted within rhizotron chambers (Meisner & Karnok, 1992), and hydroponic systems

(Pandey et al., 1986). Hydroponic assessment of root traits is particularly appealing due to its reduced labor requirements, cost effectiveness, and ease of implementation.

Aerobiological research in Dhule, Maharashtra is of urgent scientific and public health importance due to the region's specific environmental, agricultural, and health-related challenges. Dhule is located in a semi-arid zone with high agricultural activity, making it a natural hotspot for bioaerosols like pollen and fungal spores, which can significantly impact both human respiratory health and crop productivity. Yet shockingly few original research studies have been conducted directly in Dhule to assess this vital ecological aspect.

This synthesis not only underscores the multifaceted nature of aerobiological studies but also highlights exciting prospects for future research that could integrate environmental monitoring with agricultural innovation and public health improvements.

REFERENCES

[1]. Aher S. K. (2019). Environmental Monitoring of Other Bioparticles in the Airspora Over Groundnut Fields. International Journal of Research and Analytical Reviews, 6(2), 149–151. http://www.ijrar.com/upload_issue/ijrar_issue_20543898.pdf

[2]. Alderman, S. C., Matyac, C. A., Bailey, J. E., & Beute, M. K. (1987). Aeromycology of Cercospora arachidicola on peanut. Transactions of the British Mycological Society, 89(1), 97–103.

[3]. Alderman, S. C., & Nutter Jr, F. W. (1994). Effect of temperature and relative humidity on development of Cercosporidium personatum on peanut in Georgia. Plant Disease, 78(7), 690–694.

[4]. Ambhore, J. S. (2015). Aeromycological studies over maize and paddy crops. Lulu. com.

[5]. Augusto, J., & Brenneman, T. B. (2011). Implications of fungicide application timing and post-spray irrigation on disease control and peanut yield. Peanut Science, 38(1). https://doi.org/10.3146/ps10-11.1

[6]. Chavan, R. R., Ambadkar, C. V, & Bhalerao, P. B. (2021). Antagonistic Properties of Certain Biocontrol Agents Against Fusarium Oxysporum F. SP. Lycopersici and Sclerotium Rolfsii.

[7]. Cu, R. M., & Phipps, P. M. (1993). Development of a pathogen growth response model for the Virginia peanut leaf spot advisory program. Phytopathology, 83(2), 195–201.

[8]. Gaikwad, S. N., Salve, S. N., & Rajurkar, S. K. (2018). In vitro antagonistic activity of Trichoderma harzianum against soilborne fungal pathogens. Int. J Biol. Res, 3(2), 87–89.

[9]. Gorai, S. (2021). Role of Aerobiology in Plant Disease Management and Diagnosis of Allergy. In Plant-A Valuable Resource for Sustainable Agriculture, Food and Medicine (pp. 152–162). ABS BOOKS.

[10]. Heyden, H. Van der, Dutilleul, P., Charron, J., Bilodeau, G. J., & Carisse, O. (2021). Monitoring Airborne Inoculum for Improved Plant Disease Management. A Review. Agronomy for Sustainable Development. https://doi.org/10.1007/s13593-021-00694-z

[11]. Hirst, J. M. (1992). Biography of an aerobiologist PH Gregory 24.7. 1907–9.2. 1986. Aerobiologia, 8(2), 209–219.

[12]. Irwin, M. E. (1999). Implications of movement in developing and deploying integrated pest management strategies. Agricultural and Forest Meteorology, 97(4). https://doi.org/10.1016/S0168-1923(99)00069-6

[13]. Jadhav, D. S., Patil, B. Y., Dhale, D. A., & others. (2010). Airspora over groundnut fields at kalamb. J. Phytol, 2(12), 14–16.

[14]. Ketring, D. L. (1984). Root Diversity among Peanut Genotypes1,2. Crop Science, 24(2),

cropsci1984.0011183X002400020004x. https://doi.org/https://doi.org/10.2135/cropsci1984.0011183X002400020004x

[15]. Kramer, C. L., & Eversmeyer, M. G. (2013). Division of Biology and USDA-ARS, Dept. of Plant Pathology, Kansas State University, Manhattan, Kansas 66506 USA. Advances in Aerobiology: Proceedings of the 3rd International Conference on Aerobiology, August 6–9, 1986, Basel, Switzerland, 51, 313.

[16]. Kshirsagar, J. J., Dharasurkar, A. N., & Pachkore, G. L. (n.d.). FUNGAL SPORE OF GROUNDNUT FIELDS IN BEED DISTRICT.

[17]. Kumari, M., & Singh, M. (2017). Management of collar rot disease of groundnut (Arachis hypogaea L.) Caused by Aspergillus niger through bio-agents. International Journal of Chemical Studies, 5(4), 73–76. https://www.chemijournal.com/archives/2017/vol5issue4/PartB/5-3-187-928.pdf

[18]. Kurganskiy, A., Creer, S., Vere, N. de, Griffith, G., Osborne, N. J., Wheeler, B. W., McInnes, R. N., Clewlow, Y., Barber, A., Brennan, G., Hanlon, H. M., Hegarty, M., Potter, C., Rowney, F. M., Adams-Groom, B., Petch, G., Pashley, C. H., Satchwell, J., Weger, L. A. de, … Skjøth, C. (2021). Predicting the Severity of the Grass Pollen Season and the Effect of Climate Change in Northwest Europe. Science Advances. https://doi.org/10.1126/sciadv.abd7658

[19]. Lokendra Singh, L. S., & Preeti Vats, P. V. (2006). An update of aeromycological research in India with emphasis on future challenges.

[20]. Malati, H. A. (2021). Study of air-spora over the groundnut fields in Nashik District of Maharashtra, India. Schol J Agric Veterin Sci, 2(1), 15–19.

[21]. Malik, M., Singh, U., & Dahiya, S. (2002). Nutrient composition of pearl millet as influenced by genotypes and cooking methods.

[22]. Mallaiah, K. V, & Rao, A. S. (1981). Aerobiology of two species of Cercospora pathogenic to groundnut.

[23]. Mallaiah, K. V, & Rao, A. S. (1982). Aerial dissemination of urediniospores of groundnut rust. Transactions of the British Mycological Society, 78(1), 21–28.

[24]. Mallaiah, K. V, & Rao, A. S. (1987a). Aerobiology of Groundnut Rust. Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1987. Groundnut Rust Disease. Proceedings of a Discussion Group Meeting, 24-28 Sep 1984, ICRISAT Center, India. Patancheru, AP 502324, India: ICRISAT., 127.

[25]. Mallaiah, K. V, & Rao, A. S. (1987b). Aerobiology of Groundnut Rust. Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1987. Groundnut Rust Disease. Proceedings of a Discussion Group Meeting, 24-28 Sep 1984, ICRISAT Center, India. Patancheru, AP 502324, India: ICRISAT., 127.

[26]. Meisner, C. A., & Karnok, K. J. (1992). Peanut Root Response to Drought Stress. Agronomy Journal, 84(2), 159–165. https://doi.org/https://doi.org/10.2134/agronj1992.00021962008400020007x

[27]. Mhatre, K. G., & Jagtap, J. D. (2023). Glimpses of Research in Life Sciences.

[28]. Nilofar Y. Khan, Rukhsana S. Tadavi, & Gauri Rane. (2015). Isolation and identification of fungi associated with Groundnut seeds and surrounding air from Jalgaon city. A Compendium of Research Articles by Budding Researchers, 06, 14–17.

[29]. Pandey, R. K., Pendleton, J. W., & others. (1986). Genetic variation in root and shoot growth of peanut in hydroponics. Philippine Journal of Crop Science, 11(3), 189–193.

[30]. Patil, V., Shinde, P., & Ade, A. (2022). Aerobiological study with special reference to

Arachis Hypogaea L. Crop-review. Gorteria Journal, 35(I), 75–84. https://innovarjournal.com/wp-content/uploads/2022/01/GRTJ-P1045.06-F.pdf

[31]. Patil, V., Shinde, P., Ade, A., & Shinde, S. (2023). Analysis Of Air Spora Found In Two Ecologically Different Locations Of Same Crop Arachis Hypogea Linn. International Journal Of Researches In Biosciences, Agriculture And Technology, Special Issue-XI, 146–154.

[32]. Pawar, S. S., Pawar, S. G., Deokar, T. G., & Jadhav, M. G. (2015). Biodiversity of mite fauna in the intramural environment of rat house at Pune. International Journal of Life Sciences. A, 3, 11–17.

[33]. Pedrosa Jr, A. M. (1975). EVALUATION OF SEVERAL METHODS OF TAKING DISEASE SEVERITY READINGS FOR CERCOSPORA LEAFSPOT OF PEANUTS. Oklahoma State University.

[34]. Porter, D. M., & Wright, F. S. (1991). Early leafspot of peanuts: Effect of conservational tillage practices on disease development. Peanut Science, 18(2), 76–79.

[35]. Ragho, K. S. (2020). Role of pollen morphology in taxonomy and detection of adulterations in crud drugs. Journal of Plant Science and Phytopathology, 4(1), 24–27.

[36]. Rao, P. S. S., & Mallaiah, K. V. (1988). Airborne fungal spores at Nagarjunanagar. Proceedings: Plant Sciences, 98, 191–197.

[37]. Rodríguez-Rajo, F. J., Dacosta, N., & Jato, V. (2004). Airborne Olive Pollen in Vigo (Northwest Spain): A Survey to Forecast the Onset and Daily Concentrations of the Pollen Season. Grana. https://doi.org/10.1080/00173130410019622

[38]. Rodríguez-Rajo, F. J., Iglésias, I., & Jato, V. (2005). Variation Assessment of Airborne Alternaria and Cladosporium Spores at Different Bioclimatical Conditions. Mycological Research. https://doi.org/10.1017/s0953756204001777

[39]. Rodriguez-Rajo, F. J., Jato, V., & Aira, M. J. (2003). Pollen content in the atmosphere of Lugo (NW Spain) with reference to meteorological factors (1999–2001). Aerobiologia, 19, 213–225.

[40]. Rodríguez-Rajo, F. J., Méndez, J., & Jato, V. (2005). Airborne Ericaceae Pollen Grains in the Atmosphere of Vigo (Northwest Spain) and Its Relationship With Meteorological Factors. Journal of Integrative Plant Biology. https://doi.org/10.1111/j.1744-7909.2005.00092.x

[41]. Różewicz, M., Wyzińska, M., & Grabiński, J. (2021). The most important fungal diseases of cereals—Problems and possible solutions. Agronomy, 11(4), 714.

[42]. Rucker, K. S., Kvien, C. K., Holbrook, C. C., & Hook, J. E. (1995). Identification of Peanut Genotypes with Improved Drought Avoidance Traits1. Peanut Science, 22(1), 14–18. https://doi.org/10.3146/pnut.22.1.0003

[43]. Savary, S. (1986). Relative humidity and wind velocity associated with diurnal rhythmicity of aerial dispersal ofPuccinia arachidis urediniospores. Netherlands Journal of Plant Pathology, 92(3). https://doi.org/10.1007/bf02000332

[44]. Savary, S., & Janeau, J.-L. (1986). Rain-induced dispersal in Puccinia arachidis, studied by means of a rainfall simulator. Netherlands Journal of Plant Pathology, 92, 163–174.

[45]. Selvakumar, R., & Viswanathan, R. (2021). A low cost method for early detection of airborne Puccinia rust spores using glass slides and foldscope in the sugarcane field. Indian Phytopathology, 74(3), 835–837.

[46]. Settaluri, V. S., Kandala, C. V. K., Puppala, N., & Sundaram, J. (2012). Peanuts and Their Nutritional Aspects—A Review. Food and Nutrition Sciences, 03(12). https://doi.org/10.4236/fns.2012.312215

[47]. Singh, A. B., Dahiya, P., & others. (2008). Aerobiological researches on pollen and fungi in India during the last fifty years: An overview. Indian Journal of Allergy and Asthma Immunology, 22(1), 27–38.

[48]. Singh, A. B., & Mathur, C. (2021). Fungal aerobiology and Allergies in India: An overview. Progress in Mycology: An Indian Perspective, 397–417.

[49]. Thakur, V. A. (2018). Aerobiological Studies With Special Reference to Airborne Basidiospores of Ganoderma Karst. At Pune, Maharashtra, India. Annals of Plant Sciences. https://doi.org/10.21746/aps.2018.7.5.1

[50]. USDA Food Composition Database. (2020). Basic Report:16096, Peanuts, virginia, oil-roasted, with salt. https://ndb.nal.usda.gov/ndb/foods/ show/4834

[51]. Vicentini, S. N. C., Hawkins, N. J., King, K. M., Moreira, S. I., de Paiva Custódio, A. A., Leite Júnior, R. P., Portalanza, D., Garcés-Fiallos, F. R., Krug, L. D., West, J. S., & others. (2023). Aerobiology of the Wheat Blast Pathogen: Inoculum Monitoring and Detection of Fungicide Resistance Alleles. Agronomy, 13(5), 1238.

[52]. Yusnawan, E. (2013). The effectiveness of polar and non polar fractions of Ageratum conyzoides l. to control peanut rust disease and phytochemical screenings of secondary metabolites. Jurnal Hama Dan Penyakit Tumbuhan Tropika, 13(2), 159–166.