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Brief Note

DUST STORMS AS GLOBAL DISSEMINATORS OF PLANT PATHOGENS

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ABSTRACT

This contemporary mycological inquiry investigates into the escalating threat to global food security posed by the dispersal of plant pathogens through airborne dust, exemplified by the simulation of a colossal dust storm, named "Godzilla". Employing advanced computational models, researchers trace the route of *Fusarium oxysporum* spores from North Africa across the Atlantic, settling in the Caribbean and southeastern United States. The study estimates the conveyance of over 13,000 viable spores, raising concerns about their impact on agricultural regions, particularly southeastern Louisiana, Mexico, Haiti, the Dominican Republic, and Cuba. While ultraviolet radiation typically neutralizes airborne spores within three days, the focus shifts to spore viability upon landing in vulnerable agricultural zones. Proximity to the dust source in intercontinental regions intensifies the risk, emphasizing the need to understand fungal disease dynamics and identify susceptible agricultural areas. Global prevalence of *F. oxysporum* and its capacity to infect over 100 crops highlight the potential for significant crop losses and economic consequences. The research underscores the urgency of comprehending disease dissemination dynamics and protecting global food security, emphasizing regions like sub-Saharan Africa as critical sources of viable spores. The study's preliminary nature prompts a future focus on observational data acquisition, including comprehensive dust storm mapping and genetic comparisons of *F. oxysporum*, to validate the model's findings. This research work calls for proactive measures to address the escalating threat of disease, laying the ground work for forthcoming mycological endeavors.

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INTRODUCTION

As the global population continues to rise, the imperative to optimize agricultural productivity and mitigate crop losses due to plant diseases becomes increasingly vital. According to Savary et al. (2019), the optimization of crop yields through advanced practices in agricultural sciences is essential in this context. Little (2020) highlights that plant diseases cause substantial economic losses, amounting to $806 million, with affected crops valued at approximately $6.712 billion, resulting in a relative disease loss of 12.01%. To effectively combat this challenge, it is imperative to enhance intellectual awareness regarding disease spread. This necessitates the adoption of advanced technologies, such as remote sensing and data analytics, for early detection and monitoring. Moreover, embracing

integrated pest management, precision agriculture, and sustainable farming practices, along with fostering research, education, and international collaboration, will contribute to a comprehensive strategy for disease management and sustainable agricultural development. By combining these efforts, we can strive towards a resilient and productive global agricultural system capable of feeding a burgeoning population.

Dust-borne dissemination of *Fusarium oxysporum*: a contemporary threat to global food security

A contemporary mycological inquiry emphasizes the potential threat to global food security hastened by the dissemination of plant pathogens through airborne dust, traversing substantial distances. Employing sophisticated computational models, researchers composed the simulation of an expansive dust storm, denominated "Godzilla" which facilitated the transport of viable spores belonging to the *Fusarium oxysporum* fungus. Originating in North Africa, these spores voyaged across the Atlantic Ocean, ultimately settling in the Caribbean and southeastern United States. The study suggests that an overwhelming estimate exceeding 13,000 viable spores could have been conveyed, with specific repercussions for regions such as southeastern Louisiana, Mexico, Haiti, the Dominican Republic, and Cuba. While conventional ultraviolet radiation typically eradicates the majority of spores within a three-day airborne period, the focal concern lies in the spores' viability upon landing in agricultural locales. Proximity to the dust source, particularly in the intercontinental regions spanning Europe, Asia, and Northern Africa, worsens the risk due to the plausible cultivation of common crops in close proximity to dust and pathogen origins. *F. oxysporum*, omnipresent on all six continents contributing to crop production, exhibits the capacity to infect over 100 crops, resulting in substantial crop losses and economic ramifications. This research underscores the imperative to comprehend the dynamics of fungal disease dissemination and pinpoint agricultural zones susceptible to the deposition of viable spores, thereby safeguarding global food security. The researchers advocate focusing on regions such as sub-Saharan Africa, identified as a significant source of viable spores, to proactively address the escalating threat of disease. Acknowledging the preliminary nature of the study, forthcoming mycological endeavors will pivot towards the acquisition of observational data to validate the model's findings. This entails the creation of comprehensive maps explaining dust storms and the accomplishment of genetic comparisons of *F. oxysporum* between dust sources and regions experiencing outbreaks of the disease.

DISCUSSION

The association between dust transport and its biological content was initially established by Ehrenberg while examining African dust samples collected by Darwin in the 1830s (Darwin, 1846; Gorbushina et al., 2007). Approximately a century later, researchers such as Bernard E. Proctor, a Professor at the Massachusetts Institute of Technology, and Fred C. Meier, a scientist with the U.S. Department of Agriculture, conducted aircraft-based investigations focusing on the intercontinental and transoceanic dissemination of plant pathogens. Proctor observed that bacterial fungi and pollen could be anticipated at altitudes of up to approximately 6.1 kilometers based on his observations. The highest counts of colony-forming units (CFU), encompassing both bacteria and fungi, were recorded when visibility was compromised by dust transported in air masses moving over the Sargasso Sea (Proctor, 1935).

The revelation of dust-borne dispersal of plant pathogens, exemplified by the airborne journey of *F. oxysporum* spores during the simulated dust storm "Godzilla" underscores the potential threat to global agriculture. Originating in North Africa and traversing the Atlantic Ocean, these spores settled in the Caribbean and southeastern United States, raising concerns about their viability upon landing in agriculturally significant regions such as southeastern Louisiana, Mexico, Haiti, the Dominican Republic, and Cuba.

F. oxysporum, a pervasive fungus with a global footprint capable of infecting over 100 crops (Gorden, 2017), poses a substantial risk to food security, leading to potential crop losses and economic consequences. The proximity of agricultural areas to dust sources in intercontinental regions amplifies the risk, emphasizing the need to understand the dynamics of fungal disease dissemination. Recognizing vulnerable agricultural zones and taking proactive measures becomes imperative to safeguard global food security (Gonzalez-Martin, 2014).

The study advocates a targeted focus on regions like sub-Saharan Africa, identified as a notable source of viable spores, to address the escalating threat of disease. While the study acknowledges its preliminary nature, it sets the stage for future mycological research,

emphasizing the importance of acquiring observational data. This includes the development of comprehensive maps elucidating dust storms and genetic comparisons of *F. oxysporum* between dust sources and regions experiencing outbreaks, enhancing the validity of the model's findings.

In essence, a thorough comprehension and vigilant monitoring of dust-borne dispersal events emerge as pivotal components in formulating effective strategies to mitigate the impact of plant diseases on crops, contributing to the enhancement of global food security. As we navigate the intricate dynamics of our interconnected world, studies of this nature serve as beacons guiding us toward sustainable and resilient agricultural practices in the face of emerging challenges.

CONCLUSION

In the face of increasing global concerns about the threat to food security, a recent case study has shed light on a critical phenomenon-the intercontinental dispersal of *Fusarium oxysporum* through simulated dust storms, notably one dubbed "Godzilla." This simulated event, initiated in North Africa, demonstrated the remarkable ability of spores to traverse vast distances across the Atlantic Ocean, ultimately settling in the Caribbean and southeastern United States. The study's computations revealed an alarming estimate of over 13,000 viable spores of *F. oxysporum* potentially conveyed during this simulated dust storm.

AUTHOR'S CONTRIBUTIONS

The author, AA conceived the idea; AA and MS collected and compiled the literature, wrote the first draft and proofread it.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCE

Darwin, C., 1846. An account of the fine dust which often falls on Vessels in the Atlantic Ocean. Quarterly Journal of the Geological Society 2(1-2), 26-30.

Gonzalez-Martin, C., Teigell-Perez, N., Valladares, B., Griffin, D.W., 2014. The global dispersion of pathogenic microorganisms by dust storms and its relevance to agriculture. Advances in agronomy 127, 1-41.

Gorbushina, A.A., Kort, R., Schulte, A., Lazarus, D., Schnetger, B., Brumsack, H.J., Broughton, W.J., Favet, J., 2007. Life in Darwin's dust: intercontinental transport and survival of microbes in the nineteenth century. Environmental Microbiology 9(12), 2911-2922.

Gordon, T.R., 2017. *Fusarium oxysporum* and the Fusarium wilt syndrome. Annual Review of Phytopathology 55, 23-39.

Little, EL., 2020. Georgia Plant Disease Loss Estimate. University of Georgia.

Proctor, B.E., 1935. The microbiology of the upper air. II. Journal of Bacteriology 30(4), 363-375.

Savary, S., Willocquet, L., Pethybridge, S.J., Esker, P., McRoberts, N., Nelson, A., 2019. The global burden of pathogens and pests on major food crops. Nature Ecology & Evolution 3(3), 430-439.