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MEDIA RELEASE

Microorganisms could be the cause of 'fairy circle' phenomenon – UP microbiologists

University of Pretoria (UP) scientists have posited a theory that could explain the tens of thousands of "fairy circles" that can be seen dotted across the arid landscape of Namibia.

The existence of these circles has fascinated scientists for decades, and no one knows the actual cause of this phenomenon. (The Nama tribes believed the circles were caused by dragons.) There are many competing theories of their origins – one of which is that microorganisms could be the missing piece of the puzzle, according to UP researchers.

Fairy circles are bare, regularly spaced and sized patches surrounded by grass. Most are between two and five meters in diameter, and they occur over thousands of square kilometres in Namibia and into southern Angola.

"These fairy circles are unique to Namibia and southern Angola," says Prof Don Cowan, Director of UP's Centre for Microbial Ecology and Genomics. Similar "structures" have been found in Australian deserts, but that doesn't necessarily mean that they have the same causative basis.

A number of current theories could explain the phenomenon: toxic gases from deep in the soil, toxic chemicals from dead *Euphorbia* plants, sand termites or the effects of natural plant "self-organisation" processes over long periods could all have caused the formation of these circles. Each of these major theories is supported by a research group often purporting to have "discovered" the cause.

Prof Cowan and his team have investigated the cause of fairy circles and have their own theory: they think that plants growing inside the circles could be dying as a result of phytopathogenesis – the presence of pathogenic microorganisms (bacteria, fungi or viruses) in the soil.

The growth of fairy circles is reminiscent of a growing microbial culture, which is circular and spreads at the margins. While several other theories can explain plant death, they struggle to explain the growth of the circle itself.

"To test our theory, we used environmental DNA and modern metagenomic methods to investigate the bacterial and fungal diversity of soils inside the fairy circles, and compared them with control soils outside circles," Prof Cowan explains. Environmental is all the DNA that can be extracted from an environmental sample, such as a gram of soil or water.

"We found significant differences between these communities, but this is not causative proof – the usual difficulty of distinguishing between cause and effect. Interestingly, some of the unique fungal species found only in the soils inside the fairy circles are known plant pathogens, though this is also not final proof that they cause the circles. We would need to isolate these fungi as cultures and prove that they are infecting and killing the plant species."

Some proponents of the various major theories tend to ignore contrary evidence, Prof Cowan says. "For example, proponents of the *Euphorbia* theory seem to ignore the fact that fairy circles exist extensively in the gravel desert areas where *Euphorbias* do not grow and may never have grown," he explains.

There are suggestions that the effect that causes fairy circles may be complex, with possible secondary effects. Plants germinating inside fairy circles, as they do after rain, die quickly and seem to be more susceptible to drought. This implies the causative agent is somehow related to root function. "Perhaps there are multiple causes of localised plant death that generate these strange circular phenomena," Prof Cowan says. "Fairy circle structures might be caused by sand termites eating roots in one desert area, while residual toxins in the soil from dead *Euphorbia* plants might be the cause in another, and pathogenic fungi in a third."

The circles appear to have a lifespan – they seem to grow (expand) with the death of grass plants around the outer margin (which makes the circle larger). Plants around the edges of the circles grow taller and stronger than those on the outside, probably because they have less competition for nutrients and water, until they die as the circle expands.

The lifespan of a fairy circle may be about 40 years. "Interestingly, no one seems to report 'newborn' or very small fairy circles," Prof Cowan says. "Certainly, I have never seen one. Maybe they are not as visible at that size."

Studying these circles has been a great experience, Prof Cowan adds. "They are beautiful, intriguing and enigmatic, and I can see why so many scientists have focused their research on this phenomenon."

Click here to hear more about Prof Cowan's research on fairy circles: **https://youtu.be/9aWJ0d0eZgg**

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ABOUT THE UNIVERSITY OF PRETORIA

The University of Pretoria (UP) is one of the largest contact and residential universities in South Africa, with its administration offices located on the Hatfield Campus, Pretoria. This 115-year-old institution is also the largest producer of research in South Africa.

Spread over seven campuses, it has nine faculties and a business school, the Gordon Institute of Business Science (GIBS). It is the only University in the country with a Faculty of Veterinary Science, ranked top in Africa. Overall has 120 academic departments and 92 centres and institutes, accommodating more than 55 000 students and offering about 1 100 study programmes.

UP is one of the top five universities in South Africa, according to the 2019-2020 rankings by the Centre for World University Rankings. It is ranked among the top 100 universities worldwide in three fields of study (veterinary science, theology, and law) and the top 1% in eight fields of study (agricultural sciences, clinical medicine, engineering, environment/ecology, immunology, microbiology, plant and animal sciences and social sciences).

In May 2020, the annual UK Financial Times Executive Education Rankings again ranked GIBS as the top South African and African business school. The University also has an extensive community engagement programme with approximately 33 000 students involved in community upliftment. Furthermore, UP is building considerable capacities and strengths for the Fourth Industrial Revolution by preparing students for the world beyond University and offering work-readiness and entrepreneurship training.

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