Effect of Bacterial Volatile Organic Compounds on an Amphibian Fungus

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Background

There has been a global decline in amphibian populations and one major contributor is the fungus *Batrachochytrium dendrobatidis (Bd)*, which causes the disease chytridiomycosis. This pathogen infects the skin of amphibians where it can inhibit electrolyte and gas exchange, ultimately leading to death.

There are multiple methods of disease management including laboratory treatments and fungicide applications. However, many of these strategies are either ineffective or unsafe. Recent research has shown that the bacteria *Bacillus thuringiensis*, found in agricultural biopesticides, produces antifungal volatile organic compounds (VOCs) (see Fig. 1). If *Bd* growth is inhibited by these VOCs, then there should be reduced *Bd* growth when *B. thuringiensis* and *Bd* are grown adjacently. This research is an important step towards developing effective disease management strategies for amphibians using common agricultural products.

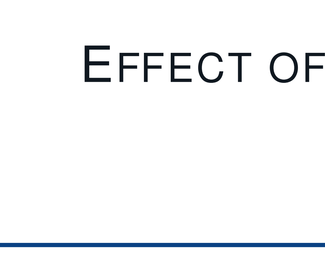

Fig. 1: **Bacteria can produce volatile organic compounds, which are organic compounds that easily become vaporised**

Methodology

- Plated on 1% tryptone nutrient agar in divided petri dish
- ⟨**No manipulation**|***B. dendrobatidis* (1 mL)** ⟩n=14
- ⟨***B. thuringiensis* subsp.*kurstaki***|***B. dendrobatidis*(1 mL)**⟩n=7
- Sealed and incubated at 21°C for 14 days
- Image J analysis used to assess percentage of Bd cover
- Statistical analyses conducted with R version 3.6.2

Results

There was a significant difference in average percent *Bd* growth between control(5.277 $\pm$ 2.4) and *Btk* treated plates (0.0393 $\pm$ 0.02) (t_{1_3}=8.15; p<0.001).

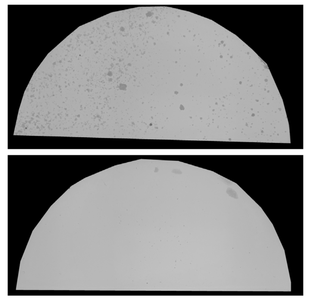

Fig. 2: ***Bd* growth without *Btk* (top) and *Bd* growth with *Btk* (bottom)**

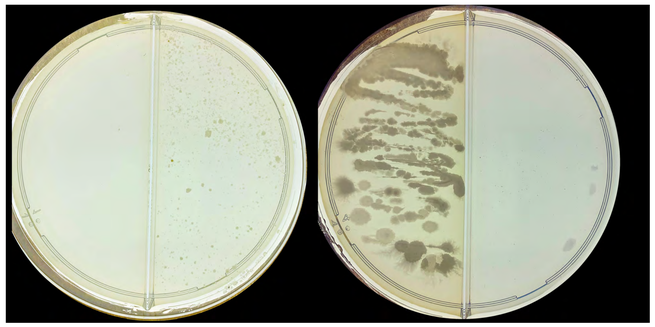

Fig. 3: **Photos taken of control (right) and treatment (left) plates to analyze percentage of Bd growth (on right side of both plates)**

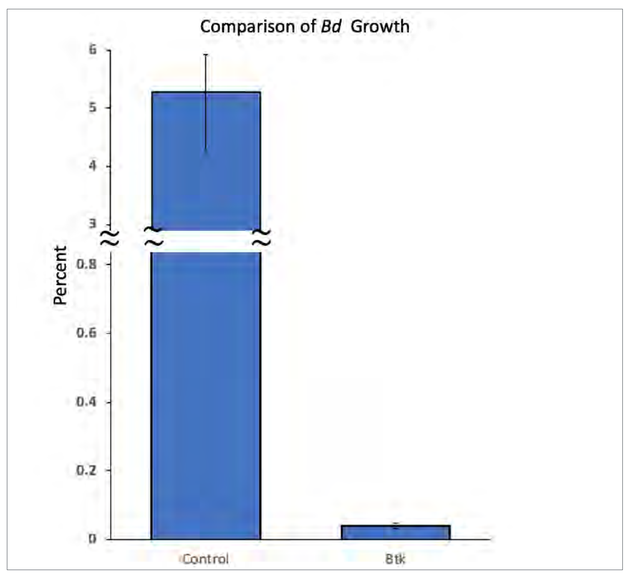

Fig. 4: **Percent of *Bd* growth after exposure to *Btk***

Discussion

The results from this study indicated that *Bacillus thuringiensis* subsp *kurstaki* significantly inhibited the growth of the pathogenic fungus *Batrachochytrium dendrobatidis* (t_{1_3}=8.15; p<0.001).

These results are consistent with preliminary results from previous research, which found that bacteria were able to produce aerosol volatile organic compounds capable of inhibiting growth of *Bd* [2].
The results from this study are also consistent with another study which found that augmenting frog skin with the bacteria *Janthinobacterium lividum* reduced *Bd* infection rates. [1]
Commonly used *Btk*- based biopesticides may be an additional tool used to combat amphibian wildlife diseases. They would also be a safer alternative to chemical pesticides that have known adverse effects in amphibians and other wildlife.
This research is an important first step towards developing effective treatments for emerging infectious diseases in wildlife populations.

Acknowledgements

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References

[1] Reid N. Harris et al. “Skin microbes on frogs prevent morbidity and mortality caused by a lethal skin fungus”. In: *The ISME Journal* 3.7 (July 2009), pp. 818–824. ISSN: 1751-7370. DOI: 10.1038/ismej.2009.27. URL: https://doi.org/10.1038/ismej.2009.27.

[2] Douglas C. Woodhams et al. “Managing Amphibian Disease with Skin Microbiota”. In: *Trends in Microbiology* 24.3 (2016), pp. 161–164. ISSN: 0966-842X. DOI: 10.1016/j.tim.2015.12.010. URL: http://www.sciencedirect.com/science/article/pii/S0966842X15003017.