

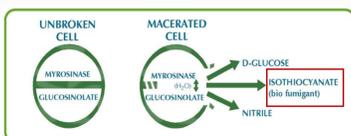
In vitro activity of *Brassica*-based isothiocyanates against mycotoxin-producer *Fusarium graminearum*



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1. Background

- Fusarium graminearum* causes Fusarium head blight in wheat, resulting in yield losses and mycotoxin (deoxynivalenol, zearalenone) contamination.
- Triazole fungicides are used to suppress *Fusarium graminearum*, however, limited effectiveness of these fungicides and concerns over safety of pesticides have led to the pursuit of safe alternatives such as biofumigation.
- Biofumigation, a low-cost approach, involves growing short term *Brassica* crops, followed by maceration of the plant tissue and rapid incorporation into the soil.
- Inhibitory substances, particularly isothiocyanates are released as a result of damage to *Brassica* plant tissue causing suppression of soil borne pests and diseases.

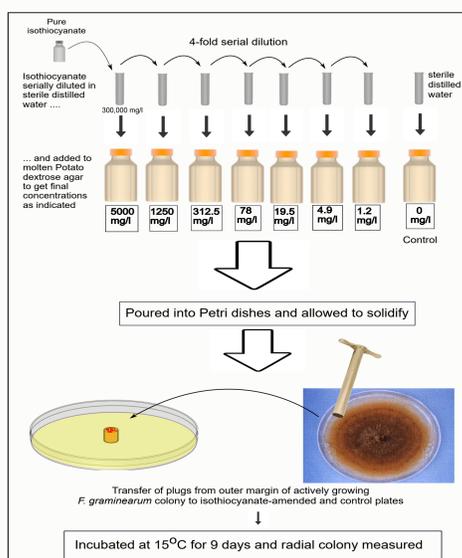


2. Why was the study performed?

Isothiocyanates were tested over a range of concentrations to identify *Brassica* species with known isothiocyanate profile which could be used as potential biofumigant against *Fusarium graminearum* in field experiments.

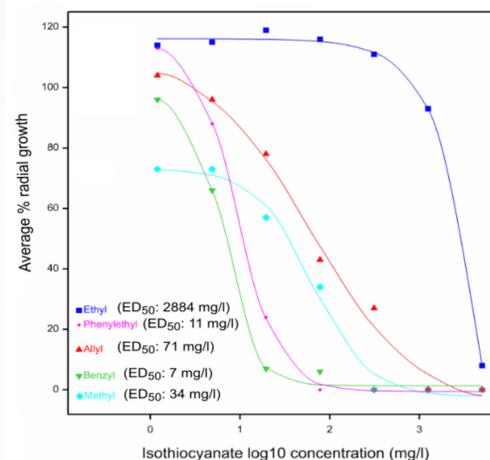
3. Materials and Method

- Five isothiocyanates- allyl, ethyl, 2-phenylethyl, methyl, benzyl- each of which were tested against 5 isolates of *Fusarium graminearum* (FG2556, FG2498, FG2560, FG2502, FG2481) as shown below:

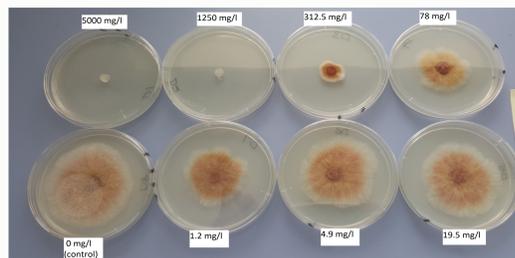


- Radial growth for each treatment was measured and % radial growth was calculated (as % of control).
- Data was best fitted with logistic curve using Genstat and ED₅₀ values were generated from the plot.

4. Results



Dose-response curves for effect of methyl, ethyl, benzyl, allyl and 2-phenylethyl isothiocyanates at concentrations 5000, 1250, 312.5, 78, 19.5, 4.9 and 1.2 mg/l (presented on log₁₀ scale) on mycelial growth of *Fusarium graminearum*. Average of the 5 isolates was taken for each isothiocyanate as similar effect was shown by all the isolates. Data was best fitted with logistic curve with separate lines for each isothiocyanate and the model accounted for 99.4% variance ($p < 0.001$).



Effect of different concentrations of allyl isothiocyanate on mycelial growth of *Fusarium graminearum* isolate FG2502. Mycelial plugs were exposed to allyl isothiocyanate-amended potato dextrose agar media and incubated at 15°C. Photo was taken on 9th day.

- All tested isothiocyanates except ethyl, showed 100% inhibition at the highest two concentrations- 5000 and 1250 mg/l.
- Benzyl and 2-phenylethyl isothiocyanates showed the strongest inhibition.
- Methyl, benzyl, 2-phenylethyl isothiocyanates showed complete inhibition at 312.5 mg/l.
- Ethyl isothiocyanate showed the weakest inhibition and at 1.2-312.5 mg/l showed 10-20% stimulation.

5. Conclusion and Future Prospects

- This study shows the ability of isothiocyanates to suppress *Fusarium graminearum* under laboratory conditions.
- The findings suggest that *Brassica* plants rich in glucosinolates could have suppressive effect on reducing the inoculum of *Fusarium graminearum* in soil prior to cereal production.
- During the ongoing issue of the use of synthetic fumigants where some fumigants are already banned and others are likely to be banned in near future, biofumigation could prove a "green" alternative solution.
- Based on this data and data from assay on conidial germination, and the known profile of isothiocyanates in different brassicas, various *Brassica* species will be tested by leaf disc assay.
- Further research will focus on investigating the effect of brassicas in glasshouse studies and in a wheat/maize crop rotation.