

In vitro screening of the effect of three glucosinolate derived nitriles on soil-borne fungi

N. Bellostas¹, E. Casanova², J. M. Garcia-Mina², J. C. Sørensen¹, H. Sørensen¹

¹Biochemistry and Natural Product Chemistry, Department of Natural Sciences, KVL, Frederiksberg, Denmark.

²Research and Development Department, Inabonos - Groupe Roullier, Orcoyen (Navarra), Spain.

Introduction

Glucosinolates are allelochemicals present in all plants of the order Capparales that are hydrolysed by endogenous enzymes (myrosinases) forming a variety of compounds with biological activity.¹ 'Biofumigation' is the term used to describe the effect of these compounds on soil-borne pathogens and it has normally been attributed to isothiocyanates. At acidic pH and in the presence of redox co-factors such as glutathione, glucosinolate hydrolysis yields also nitriles, which are more hydrophilic and stable than isothiocyanates.¹

Results

Allyl nitrile was the least effective of the three nitriles tested although the four fungi were very differently affected. *Aphanomyces* and *Gaeumannomyces* were activated in their growth even at 20 mM of allyl nitrile, whereas *Pseudocercospora* and *Verticillium* were only weakly inhibited (less than 10%) at 8 mM and 35 mM respectively.

LD₅₀ values for benzyl nitrile ranged between 1.5-2.5 mM for all fungi, except for *Gaeumannomyces* with LD₅₀ values of about 0.5 mM (Figure 1-left). Phenethyl nitrile was even more effective than benzyl nitrile, with LD₅₀ values lower than 1.5 mM except for *Verticillium* with LD₅₀ values of almost 2.5 mM (Figure 1-right).

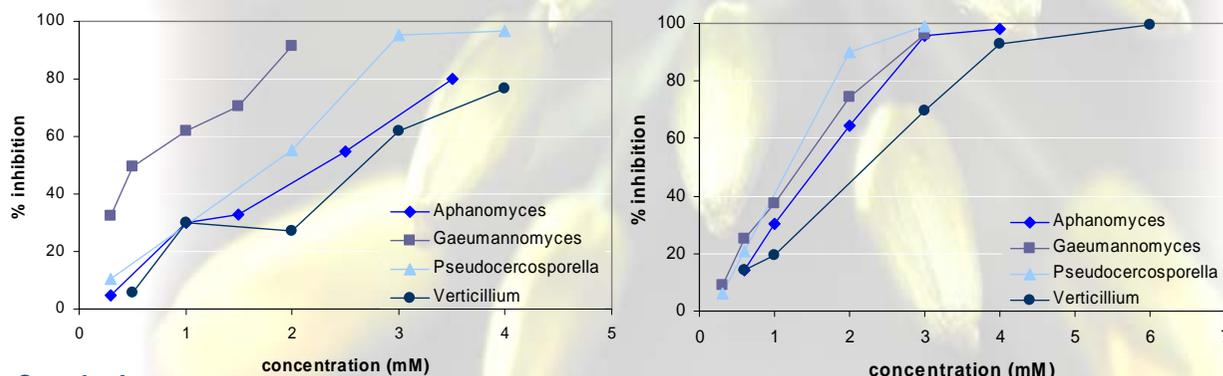


Figure 1. Dose dependent toxicity of benzyl (left) and phenethyl (right) nitriles on the four fungi tested.

Conclusions

Allyl nitrile did not inhibit significantly the growth of any of the fungi tested, in contrast to the high toxicity of allyl isothiocyanate (Sarwar et al., 1998). The fungi showed different resistance against benzyl and phenethyl nitriles. In the case of the cereal pathogen *Gaeumannomyces*, the LD₅₀ value for phenethyl nitrile was below 1.5 mM, which is up to 50 times higher than the LD₅₀ value reported for phenethyl isothiocyanate (Smith and Kirkegaard, 2002). Despite their lower toxicity compared to isothiocyanates, nitriles are generally more soluble in water, which may allow them to persist longer in soils. Nitriles are produced at low pH and in the presence of thiol groups and ferrous ions, which can be quite common in soils, therefore, the role of nitriles in biofumigation should also be considered.

References

- Sørensen, H. 1990. In: Rapeseed/Canola: Production, Chemistry, Nutrition and Processing Technology. Van Nostrand Reinhold Publisher.
- Sørensen, J. C. 2001. PhD Thesis, The Royal Veterinary and Agricultural University, Copenhagen, Denmark.
- Sarwar, M., Kirkegaard, J. A., Wong, P. T. W., Desmarchelier, J. M. 1998. Plant and Soil. 201, 103-112.
- Smith, B. J., Kirkegaard, J. A. 2002. Plant Pathology. 51, 585-593.