



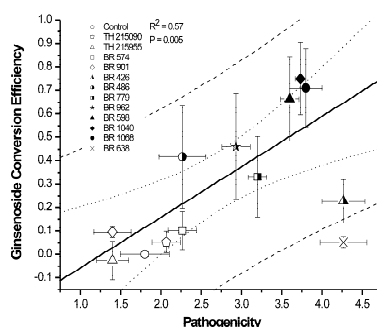
## THE CHEMOATTRACTANT POTENTIAL OF GINSENOSES IN THE GINSENG-*PYTHIUM IRREGULARE* PATHOSYSTEM

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**Abstract:** Ginsenosides, the triterpenoid saponins produced by American ginseng (*Panax quinquefolius* L.), have been extensively studied for their medicinal value, however their function in the rhizosphere remains unknown. Similar to other saponins, ginsenosides, possess antifungal properties against root and non-root pathogenic fungal species. However, growth of the ginseng root pathogen *Pythium irregulare* Buisman, is stimulated when exposed to ginsenosides [1,2] and this oomycete, also, is able to partially deglycosylate the 20(S)-protopanaxadiol ginsenosides Rb1, Rd and gypenoside XVII via extracellular glycosidases, leading to a common product, ginsenoside F2 [3,4]. Previously, it has been shown that the ability of nine distinct isolates of *P. irregulare* to deglycosylate 20(S)-protopanaxadiols, *in vitro* was correlated to the pathogenicity of each isolate towards one- and two- year old ginseng seedlings [5] (Fig 1). Therefore it was hypothesized that these glycosidases help *Pythium* find its host and or obtain nutrients/growth factors from the environment. Furthermore, it has been speculated that ginsenoside F2, the common product of this ginsenoside metabolism, could act as a host recognition factor for *P. irregulare* facilitating the production of ginsenosidases and up-regulating the growth of the organism. Presently, the chemoattractant potential of ginsenosides for *P. irregulare* was evaluated through (1) an *in vivo* pot experiment that monitored the pathogenicity of *P. irregulare* toward ginsenoside-treated and -untreated one- and two- year old ginseng plants and (2) by monitoring the affects of a purified total ginsenoside extract (GSF) and pure ginsenosides (Rb1, Re and F2) on the growth of the pathogen, *in vitro*. Disease severity and Time to Infection (TTI) was evaluated *in vivo*, by monitoring the chlorophyll fluorescence parameter  $\Phi_{NO}$  through non-invasive Chl fluorescence imaging in whole leaves of infected plants. Treatment of ginseng roots with a relatively high dose of ginsenosides prior to planting resulted in delayed infection by *P. irregulare*, of both one- and two-year old ginseng plants. Meanwhile, *in vitro* exposure of *P. irregulare* to pure ginsenoside extracts and GSF enhanced and altered mycelial growth. While, these results do not definitively show that ginsenosides act as chemoattractants for *P. irregulare*, they do demonstrate that rhizosphere ginsenosides affect the growth pattern of *P. irregulare* *in vivo*, which can affect the severity of its pathogenicity.

Figure 1:



### References:

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- [2] Nicol, R.W., Yousef, L., Traquair, J.A. and Bernards, M.A. 2003. Ginsenosides stimulate the growth of soilborne pathogens of American ginseng. *Phytochemistry* 64: 257-264.
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- [4] Yousef, L.F. and Bernards, M.A. 2006. *In vitro* metabolism of ginsenosides by the ginseng root pathogen *Pythium irregulare*. *Phytochemistry* 67, 1740-1749.
- [5] Ivanov, D.A. and Bernards, M.A. 2012. Ginsenosidases and the pathogenicity of *Pythium irregulare*. *Phytochemistry*. 78: 44-53.