Plant Pathology Seminar Series

“Chemosensitization: A Strategy to Overcome Fungicide Resistance”

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One of the challenges encountered with the use of fungicides for crop protection is the emergence of fungicide resistant fungal pathogens. The increasing resistance severely undermines the efficacy of fungicides and may warrant increased spray dosages with different groups of fungicides for controlling fungal diseases. In the long run, this could become more expensive for growers and unsustainable from the human health and environmental protection perspective. A potential strategy for overcoming this problem is enhancement of pathogen sensitivity to fungicides by ‘chemosensitization’. Chemosensitization is accomplished by applying a combination of a commercial fungicide with another substance that has non- or marginally fungicidal properties at levels where neither component would be effective on its own. This leads to a synergistic interaction between the two, thereby augmenting fungicide efficacy. This augmentation ultimately lowers effective fungicide dosages, costs, side effects, and counteracts resistance (Campbell et al. 2012; Dzhavakhiya et al. 2012; Kim et al. 2010). The main function of chemosensitizing agents is to disrupt fungal stress responses, destabilize structural integrity of cellular membranes, or stimulate production of reactive oxygen species within the fungi, ultimately causing oxidative stress and death (Campbell et al. 2012; Kim et al. 2006; Kim et al. 2017).

Research on applying chemosensitization against the emergence of fungicide resistance in fungal pathogens is still in its infancy. However, a number of reports have shown the potential of chemosensitization in controlling fungal pathogens. Benzo analogs, such as 2,3-Dihydroxybenzaldehyde, 2,3-Dihydroxybenzoic acid, Octylgallate, and Veratraldehyde demonstrated synergism with and subsequent augmentation of commercial fungicides (Campbell et al. 2012; Kim et al. 2008; Kim et al. 2014). Redox-active natural plant phenolics Vanillin, Vanillic acid, Cinnamic acid, Thymol, and others have been used to successfully overcome fungicide resistance (Dzhavakhiya et al. 2012; Kim et al. 2006). Besides these plant-derived compounds, certain bacterial metabolites have also shown chemosensitizing potential. *Bacillus amyloliquefaciens* strain JCK-12 produces cyclic lipopeptides that have demonstrated synergism with several antifungal agents (Kim et al. 2017). These findings have important implications in terms of controlling fungal plant pathogens that have propensity to develop resistance to commercial fungicides as well as reducing the environmental impact of agrochemicals.

4:10 pm | Monday, March 19 | Johnson Hall 343

Plant Pathology 515, Spring 2018

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References

Campbell, B. C., Chan, K. L., and Kim, J. H. 2012. Chemosensitization as a means to augment commercial antifungal agents. Front Microbiol. 3 (79): 1-20.

Dzhavakhiya, V., Shcherbakova, L., Semina, Y., Zhemchuzhina, N., and Campbell, B. 2012. Chemosensitization of plant pathogenic fungi to agricultural fungicides. Front Microbiol. 3 (87): 1-9.

Kim, J. H., Campbell, B. C., Mahoney, N., Chan, K. L., and May, G. S. 2006. Targeting antioxidative signal transduction and stress response system: control of pathogenic *Aspergillus* with phenolics that inhibit mitochondrial function. J Appl Microbiol. 101: 181-189.

Kim, J. H., Mahoney, N., Chan, K. L., Molyneux, R. J., May, G. S., and Campbell, B. C. 2008. Chemosensitization of fungal pathogens to antimicrobial agents using benzo analogs. FEMS Microbiol Lett. 281: 64-72.

Kim, J. H. Campbell, B. C., Mahoney, N., Chan, K. L., Molyneux, R. J., and Xiao, C. L. 2010. Use of chemosensitization to overcome fludioxonil resistance in *Penicillium expansum*. Lett Appl Microbiol. 51: 177-183.

Kim, J. H., Mahoney, N., Chan, K. L., Campbell, B. C., Haff, R. P., and Stanker, L. H. 2014. Use of benzo analogs to enhance antimycotic activity of kresoxim methyl for control of aflatoxigenic fungal pathogens. Front Microbiol. 5 (87): 1-12.

Kim, K., Lee, Y., Ha, A., Kim, J., Park, A. R., Yu, N. H., Son, H., Choi, G. J., Park, H. W., Lee, C. W., Lee, T., Lee, Y., and Kim, J. 2017. Chemosensitization of *Fusarium graminearum* to Chemical Fungicides Using Cyclic Lipopeptides Produced by *Bacillus amyloliquefaciens* Strain JCK-12. Front Plant Sci. 8 (2010): 1-16.