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Identification and functional analysis of cytochrome P450 CYP346 family genes associated with phosphine resistance in *Tribolium castaneum*

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ABSTRACT

Resistance to phosphine fumigation has been frequently reported in insect pests of stored products and remains one of the obstacles in controlling these pests, including *Tribolium castaneum* (Herbst). In this study, six field populations of *T. castaneum* were collected from different localities in China. Bioassay data showed that SZ population was strongly resistant to phosphine, followed by moderate-resistance populations WL and SF, and three susceptible populations JX, YN, and ML. In addition, synergism assays showed that PBO significantly increased the toxicity of phosphine in resistant population SZ. Furthermore, CYP346B subfamily genes: CYP346B1, CYP346B2, and CYP346B3, were significantly overexpressed in resistant populations. Expression of CYP346B1, CYP346B2, and CYP346B3 were significantly upregulated following exposure to phosphine. RNAi assays showed that depletions on the expression levels of CYP346B1, CYP346B2, and CYP346B3 resulted in an increase of susceptibility to phosphine in *T. castaneum*. Our data demonstrated that CYP346B subfamily genes in *T. castaneum* were associated with the resistance of phosphine. Moreover, the study also advanced our understanding of phosphine resistance at the molecular level in stored pest insects.

Keywords: *Tribolium castaneum* , Phosphine resistance, P450, Overexpression, RNAi