



## Integrative analysis of transcriptomics and metabolomics reveals the toxic mechanism of spirotetramethrin on *Panonychus citri* (Acari: Tetranychidae)\*

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\*In: Zhang, Z.-Q., Fan, Q.-H., Heath, A.C.G. & Minor, M.A. (Eds) (2022) *Acarological Frontiers: Proceedings of the XVI International Congress of Acarology (1–5 Dec. 2022, Auckland, New Zealand)*. Magnolia Press, Auckland, 328 pp.

After insecticides are used in the field, their toxicity will gradually decrease to sublethal concentration with the passage of time and environmental factors, and some pest individuals will be exposed to sublethal concentrations, which will result in the sublethal effects. Therefore, understanding the sublethal effects of pesticides is the key to examine their efficacy and evaluate pesticide risk management. *Panonychus citri* McGregor (Acari: Tetranychidae) is a key citrus pest in the world and its control is largely based on the use of acaricides, such as spirotetramethrin. In this study, the sublethal effects of spirotetramethrin on population parameters of *Panonychus citri* adult females were evaluated. The results showed that sublethal concentration of spirotetramethrin significantly reduced in the longevity and fecundity of female adults, and the effects increased with increasing tested concentrations (LC<sub>30</sub>, LC<sub>50</sub>). In order to characterise the spirotetramethrin molecular mechanism, the transcriptomes and metabolomics of spirotetramethrin-treated (two sublethal concentrations LC<sub>30</sub> and LC<sub>50</sub>) and untreated adult females were compared using RNA-sequencing and LC-MS. The RNA-seq results revealed that the immune defense, antioxidative system, cuticle formation and lipid metabolic pathway of *P. citri* were involved in the responses to spirotetramethrin stress. Moreover, based on the disordered lipid metabolic pathways obtained from transcriptomic studies, the sublethal effects of spirotetramethrin on *P. citri* were examined by LC-MS; the results showed that the tolerance metabolism of *P. citri* exposed to spirotetramethrin was regulated by enhancing the metabolism of glycerophospholipid and glycine, serine and threonine. In the present study, transcriptomics and metabolomics-based approaches were employed to examine the molecular mechanism of spirotetramethrin-induced sublethal effects on *P. citri*, and the results provide new insights into the defense mechanisms at the molecular and biochemical level, and valuable information for pest control strategy development.

**Keywords:** Ecotoxicity, tolerance mechanisms, RNA-Seq, comparative metabolomics, sublethal effect, population parameters