Comparison of the detoxification enzymes activities in the avermectin-resistant and susceptible strains of *Neoseiulus cucumeris* (Oudemans) (Acari: Phytoseiidae)

XIA CHEN¹, YU-PING ZHANG², LI SUN¹, YUAN ZHEN², YAN-XUAN ZHANG¹ & JIAN-ZHEN LIN¹

¹ Research Center of Engineering and Technology of Natural Enemy Resource of Crop Pest in Fujian, Institute of Plant Protection, Fujian Academy of Agricultural Sciences, Fuzhou 350013, China; correspondence to Xia Chen <405593754@qq.com>, Yan-Xuan Zhang <xuan7616@sina.com>
² Plant Protection Institute, Guangdong Academy of Agricultural Sciences, Guangdong Provincial Key Laboratory of High Technology for Plant Protection, Guangzhou, Guangdong, China.

The predatory mite *Neoseiulus cucumeris* (Oudemans), also known as *Amblyseius cucumeris*, belongs to the family Phytoseiidae and is among the most effective known natural enemies of crop pests (McMurtry et al. 2013). For many years, this species has been used as a biological control agent for thrips and spider mites in greenhouses growing vegetables and flowers (Zhang 2006). It was successfully introduced into China (Zhang et al. 2006). However, this predatory mite is very susceptible to insecticides (Chen et al. 2004; Chen et al. 2005; Chen et al. 2006; Chen et al. 2007a; Chen et al. 2007b; Chen et al. 2010; Zhang et al. 2011; You et al. 2016), and this shortcoming has severely restricted its scope and effectiveness for use in pest control. In order to alleviate the contradiction between biological control and chemical control in the field, we had bred an avermectin-resistant strains of *N. cucumeris*: the LC50 of the susceptible strain was only 2.5 mg/L, whereas that of the resistant strain was increased to 163.2 mg/L—64.62-fold increase (Chen et al. 2011a). The LC50 of imidacloprid in susceptible and resistant strains was 132.5 mg/L and 2497.8 mg/L, respectively, representing an increase of 17.85-fold (Chen et al. 2013). We compared life history parameters between resistant and susceptible strains to determine the relative fitness of the avermectin-resistant *N. cucumeris* strain (Chen et al. 2017).

Metabolic resistance, caused by an increased metabolic capacity of insect detoxification, is one of the most important mechanisms of insect resistance to insecticides (Xing et al. 2010). Carboxylesterase (CarE), glutathione-S-transferase (GST) and mixed-function oxidase (MFO) are important detoxifying enzymes in insects that are primarily responsible for mediating resistance to insecticides (Guo et al. 2015). In particular, a decrease in acetylcholinesterase (AChE) sensitivity to insecticides is an important mechanism that can lead the emergence of resistant insects (Fourniera & Mutero 1994). Here, we investigated the activities of detoxification enzymes in avermectin-resistant and susceptible strains to assess their potential roles in avermectin resistance in this predatory mite species.

The source, rearing and other information about resistant and susceptible strains of *N. cucumeris* were detailed in detail in Chen et al. (2017). The activity of CarE, GST and AChE were measured using an Esterase activity assay kit, Glutathione -S- transferase assay kit and Acetylcholinesterase test kit from the Nanjing Jianchen Biological Engineering Institute following the manufacturer’s instructions. The activity of MFO was measured using an insect mixed-function oxidase ELISA kit from the Shanghai Jianglai Biotechnology Co., Ltd. following the manufacturer’s instructions. The activity of CarE, GST, AChE and MFO in susceptible and resistant strains was analysed by GraphPad Prism software, and comparison of groups using t-tests.