



## Behavioral and physiological responses of the parasitoid wasp *Diachasmimorpha longicaudata* (Hymenoptera: Braconidae) under exposure to spinosad insecticide

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Side effects of insecticides has been a topic of concern in last decades as the indiscriminate use of chemicals has been shown to have a negative impact on beneficial insects. Thus, this study was conducted aiming to assess the potential impacts of the insecticide spinosad on the survival, the respiration and the locomotion behavior of the fruit fly larvae parasitoid *Diachasmimorpha longicaudata*. Results showed significant ( $P < 0.05$ ) sex dependent responses of *D. longicaudata* after 24 hours of contact exposure to spinosad field rate (i.e., 96 mg a.i./L) for all three parameters studied. Although longevity has been reduced for both sexes, males suffered a sharper decrease of median survival time (from  $244 \pm 22.4$  to  $64.9 \pm 5.3$  h). In the locomotory assays, where males and females were separately subjected for 10 min to walking experiments, the treated males exhibited a significant decrease ( $P < 0.05$ ) in the walked distance, velocity and time spent walking, and an increase in the number of stops when compared to untreated ones. Intriguingly, the females showed a completely opposite trend. The treated females walked longer distance, spent more time walking and walked faster than untreated females. Locomotion parameters alterations were mirrored on the respiration responses of the females and males wasp adults. Respiration rates were significantly ( $P = 0.0418$ ) higher in treated females ( $8.02 \pm 0.44 \mu\text{L CO}_2/\text{h/insect}$ ) when compared to untreated females ( $6.47 \pm 0.36 \mu\text{L CO}_2/\text{h/insect}$ ) while unchanged for males. Thus, our findings indicated that the impacts of spinosad on *D. longicaudata* males might reduce the efficacy of these parasitoids as biological control agents.

**Keywords:** sublethal effects, insect locomotion, respiratory responses.

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## Sodium chloride enhances the control efficacy of neonicotinoid imidacloprid on the Neotropical stink bug *Euschistus heros* (Hemiptera: Pentatomidae)

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The Neotropical stink bug *Euschistus heros* is a major pest in Brazilian soybean fields. Following the ban on organophosphate insecticides, *E. heros* control was achieved mainly by the application of neonicotinoid insecticides. Previous studies have shown that the use of sodium chloride (NaCl) enhanced the efficacy of control of some organophosphate insecticides, however, the effects of NaCl on neonicotinoids have been completely neglected. This study was therefore conducted to evaluate whether adding NaCl would increase the efficacy of control of the neonicotinoid imidacloprid on *E. heros*. We established the lethal concentrations (LCs) of imidacloprid on the presence of NaCl (0.5g/L) to adult, 5<sup>th</sup> and 4<sup>th</sup> instars of *E. heros*. The insects were subjected to contact exposures to dry residues of imidacloprid for 48h. At least seven insecticide concentrations (ranging from 0.0126 to 42  $\mu\text{g a.i./cm}^2$ ) were used to established the LC values. Distilled water with and without the addition of NaCl (0.5g/L) were used as control treatments. While no significant differences were observed for imidacloprid LC<sub>50</sub> without NaCl (Adults: 1.24  $\mu\text{g a.i./cm}^2$  [0.85 – 1.87]. 5<sup>th</sup> instar: 1.49  $\mu\text{g a.i./cm}^2$  [1.07 – 2.12]. 4<sup>th</sup> instar: 1.49  $\mu\text{g a.i./cm}^2$  [1.03 – 2.20]), the addition of NaCl potentiated the imidacloprid efficacy for adults (0.15  $\mu\text{g a.i./cm}^2$  [0.11 – 0.22]) and 5<sup>th</sup> instar (0.42  $\mu\text{g a.i./cm}^2$  [0.33 – 0.65]) but not for the 4<sup>th</sup> instar (0.91  $\mu\text{g a.i./cm}^2$  [0.65 – 1.31]). Thus, here we demonstrated that addition of NaCl enhances the efficacy of control of imidacloprid, which can extend the efficacy of this control tool and might postpone the selection of resistant individuals.

**Keywords:** insecticide toxicology, neonicotinoids, integrated pest management.

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