Influence of essential oils from *Lippia alba* genotypes and their major monoterpenes against stored grain insects

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The insects *Sitophilus zeamais* and *Tribolium castaneum* cause losses in stored grains and are considered pests of wide distribution and global significance. In the present study, we evaluated the toxicity and repellency of essential oils of different *Lippia alba* genotypes (carvone genotypes LA-13 and LA-57 and citral genotypes LA-10 and LA-44) and their major monoterpenes, carvone and citral, on *S. zeamais* and *T. castaneum.* Toxicity bioassays by exposure of the insects on treated filter paper were performed to determine the concentration and lethal time. Repellency tests were performed using the most toxic compounds according to the toxicity bioassays. The carvone genotypes were more toxic than the citral genotypes for both species: for *S. zeamais*, the LC_{50} values were 15.2 µL/mL (LA-13) and 16.7 µL/mL (LA-57) and for *T. castaneum,* the LC_{50} values were 28.7 µL/mL (LA-13) and 19.7 µL/mL (LA-57). Isolated carvone (LC_{50} = 8.8 µL/mL) was more toxic than citral. For *S. zeamais*, the monoterpene citral had the lowest lethal time (LT_{50} = 6 h), whereas for *T castaneum*, the monoterpenes carvone and citral showed a more rapid toxicity (LT_{50} = 7.3 h). The compounds tested were highly repellent to *T. castaneum*; however, no repellency's effect was observed against *S. zeamais*, except for LA-13 genotype. The essential oils from the carvone genotype and the monoterpene carvone have potential for the development of natural insecticides against stored grain insects *S. zeamais* and *T. castaneum*.

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