Effect of Organic Materials Review Institute-Certified Bacillus thuringiensis Bio-insecticide on Daphnia magna Swimming Behavior

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Daphnia magna is a large, invertebrate water flea species in fresh and brackish waterbodies. The Bacillus thuringiensis (B.t.) strain is a soil bacterium that produces toxic proteins which affect targeted insect larvae. It is globally used as a non-synthetic insecticide in the billion-dollar organic market. Based on previous studies and bio-insecticide manufacturer Monterey's claims, D. magna exposed to B.t. bio-insecticide for 48 hours should not experience statistically significant behavioral changes as measured by somersaults and quadrant switches over two minutes, and should not exhibit behavioral changes when transferred back to springwater for the 96-hour post-exposure. B.t. bio-insecticide should also not cause statistically significant change in dissolved oxygen (DO) levels. The behavior of 45 adult D. magna was analyzed using a LEICA EZ4 W stereoscope, with 38 D. magna remaining after the post-exposure period. As shown by the p-values of 0.00724 (p=0.05) and 0.0102 (p=0.05) when comparing somersaults and quadrant switches from springwater to solution exposure, the presence of bio-insecticide caused statistically significant behavioral change. However, after subsequent transfer to springwater post-exposure for 96 hours, behavioral changes were partially resolved. In addition, at 24 and 48 hours, the DO levels of 50% dilution and solution dropped below the lowest observable effective DO concentration of 2 mg/L. The role of D. magna as a consumer and provider in freshwater ecosystems would be negatively impacted, as energy would be expended by abnormal swimming behavior. Additional research is needed to determine the extent that B.t. bio-insecticide affects aquatic micro-organisms at varying concentrations.

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