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Herbicidal activity of a nano-mixture of eugenol and phenylethyl propionate against tribenuron-methyl resistant biotypes of *Sinapis arvensis* L.

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Although synthetic herbicides are very effective, there is high risk of herbicide resistance and residue in the environment. Thus, there is a need to develop weed management options that are safe and as efficient as synthetic herbicides. Bio-herbicides such as essential oils are natural compounds, which are considered to be environmentally benign. Our research aimed to develop an essential oil based bio-herbicide using nano-technology. The present study was conducted to evaluate the phytotoxic effect of a nano-emulsion mixture of eugenol and phenylethyl propionate essential oils against tribenuron-methyl resistant (R1 and R2) (both with a mutation at the Ala122 position) and susceptible (S) biotypes of *Sinapis arvensis* L. An oil/water nano-emulsion (NE) was obtained using an ultrasonic homogenizer (320 W for 300 seconds) using 80% (v/v) water, a 10% (v/v) of a mixture of eugenol and phenylethyl propionate (5% of each) and 10% (v/v) of a mixture of surfactants (56% Span 80 and 44% Tween 80). The post-emergence herbicidal activity of the NE mixture (at 0, 0.6, 1.25, 1.87, 2.5 and 5% v/v) was tested in a dose response trial using a backpack sprayer (fitted with an 8002VS nozzle operated at 345 kPa, spray volume of 281 L/ha) on the 2-4 true leaves stage of pot-grown plants of the herbicide-resistant and-susceptible biotypes. The NE mixture, with an average droplet size of about 112 nm, negatively affected not only the growth but also the total chlorophyll and electric leakage from leaves. It was estimated that a concentration of 1.43, 1.44 and 1.46 % was required for 50 % decrease in weight for R1, R2 and S biotypes, respectively. In conclusion, the results of this study indicated that the NE mixture affected the growth, photosynthetic efficiency and cell membrane disruption of both the resistant and susceptible biotypes. Hence, this nanoformulation looks as an effective bioherbicide for weed control.

Keywords: Nanotechnology, Natural herbicide, Total chlorophyll, Electric leakage.