Evaluation of persistence, efficacy and volatilization of a new dicamba based nanoformulation

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Nanoformulated pesticides can be a possible solution to reduce environmental contamination, as the use of nanomaterials can reduce leaching and volatilization. The objective of the study was to evaluate persistence, efficacy and volatilization of a clay-based dicamba nanoformulation, compared to a commercial product. Data collected were compared through descriptive analysis, one-way ANOVA and REGWF post-hoc test at $P<0.05$. The persistence of the nanoformulation was studied analyzing its dissipation in a standard soil for 40 days. Post-emergence efficacy was tested through greenhouse trials on sensitive broadleaf weeds (*Amaranthus retroflexus* and *Centaurea cyanus*) treated at 98, 195 and 293 g ha^{-1} of dicamba, corresponding to the minimum, medium and maximum label rate of refence commercial formulation, respectively. Because of its partial radical activity, the efficacy of the nanoformulation was also evaluated in pre-emergence trials, that were first conducted in Petri dishes kept in growth chamber on seed germination of *A. retroflexus* and *C. cyanus* and subsequently in greenhouse on seedlings *A. retroflexus* and *Portulaca oleracea*. Eventually, a preliminary test on volatilization was conducted in greenhouse, by visually evaluating phytotoxicity damage on sensitive soybean plants exposed to vapors arising from different treated surfaces (plastic, wet soil, dry soil, grass sod and other soybean plants). Degradation studies highlighted that the nanoformulation half-life (6.7 days) was shorter than the commercial product half-life (10.9 days). In post-emergence trials, visual evaluation of the damage on *A. retroflexus* showed that the nanoformulation average efficacy was 93%, not significantly different from the commercial product (97%). Moreover, adding an adjuvant to the nanoformulation helped enhancing its efficacy to 98%. On *A. retroflexus*, pre-emergence tests highlighted high efficacy of the nanoformulation in Petri dish, where average germination rate for seeds treated at medium and maximum doses was 1.5%, whereas in greenhouse conditions data showed high variability. However, medium and maximum doses of the nanoformulation significantly inhibited the emergence of *P. oleracea* in greenhouse conditions and visual efficacy rate was >90%. Preliminary volatilization tests highlighted possible lower volatilization of the nanoformulation from treated soybean leaf surface compared to the commercial product. Phytotoxicity damage rate was approximatively 10% with the nanoformulation, while the commercial product showed a significantly higher value (23%). While maintain a good efficacy, this nanoformulation may be a promising solution to reduce leaching and volatilization of dicamba.

Keywords: *nanoherbicide, dicamba, volatility*

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