Pesticides are more toxic for soil organisms in dry soil and at enhanced temperatures

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Folsomia candida. Credit: C. Bandow

Soil organisms react more sensitive to marketable pesticides when exposed in dry soil and at enhanced temperatures. Both conditions may occur more often in the future due to climate change. Singularly and combined these factors lower the toxicity threshold of fungicides for springtails. The study by scientists from the LOEWE Biodiversity and Climate Research Centre (BiK-F), the Goethe University and the ECT

Oekotoxikologie GmbH was published in the September issue of the journal *Applied Soil Ecology*.

Springtails are tiny, about 10 mm large creatures, which participate in essential soil functions. Its numerous species, include Folsomia candida and Sinella curviseta, and are widely distributed. They form part of a huge crowd of soil organisms, which decompose organic material and build up humus. If springtails are affected, therefore soil fertility will be affected too.

As the new study shows, low soil moisture (i.e. 30 % of the water holding capacity) leads to significant reduction of springtail juveniles. "We experimented with two different species of springtails. Both of them – but especially Folsomia candida – might have difficulties to produce enough offspring to keep a population stable in dry soil," says Cornelia Bandow, an ecologist at ECT Ecotoxicology GmbH, who conducts research for the German Biodiversity and Climate Research Centre (BiK-F).

Extreme climate conditions may also alter the effect of pesticides on soil organisms. "Low soil moisture and enhanced temperatures significantly lower the threshold upon which the fungicide pyrimethanil may be toxic," explains Cornelia Bandow. In the framework of this study the toxic threshold refers to the concentration of the fungicide at which the population is 50 % less than in an uncontaminated soil. Thus at 26 degrees and a soil moisture of 30 % the threshold was up to half of the threshold that was measured at 20 degrees and 50 % soil moisture.

The experiment was conducted using 66 test vessels filled with a standard soil which was treated with different concentrations of pyrimethanil. Pyrimethanil is a broad spectrum fungicide, which is used on strawberries, pome fruit and vine to protect against and treat fungal infestation. To test for future climate conditions, the experiments were

performed independently at two different temperatures of 20 degrees and 26 degrees. The soil was furthermore moistened to different moisture levels. After 28 days researchers counted the individuals to determine the reproductive success of the model organisms under the different climatic conditions.

Sinella curviseta. Credit: C. Bandow

Should fungicides thus be avoided at all so as not to harm soil organisms? Not necessarily. "A risk for springtails under field conditions may not be expected as the toxic threshold of pyrimethanil is far above the maximum concentrations that may occur in soil if the fungicide is used according to existing regulations," says Bandow and adds "It

depends on the species and the substance whether the sensitivity alters under extreme climate conditions or not." Therefore, the researchers also plan to test several other pesticides using a variety of soil organisms.

More information: Bandow, Cornelia, Karau, Nora, Römbke, Jörg. "Interactive effects of pyrimethanil, soil moisture and temperature on Folsomia candida and Sinella curviseta (Collembola)." *Applied Soil Ecology*, DOI: 10.1016/j.apsoil.2014.04.010

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