

Science for Environment Policy

Orchard management practices may lead to changes in diversity of spiders

Different management practices using pesticides affect the diversity, number and ecological traits of ground spiders in apple orchards, a new study finds. Because spiders are viewed as good indicators of the quality of an entire ecosystem, the results reveal that organic orchard management may be better for local management and landscape characteristics when compared to those with pesticide use.

Apple orchards are a source of income for many farmers around the world. In France, they comprise approximately 54 000 hectares and are maintained with intensive spraying of **pesticides**. Orchard treatment practices can be split up into three approaches: conventional, integrated pest management (IPM), and organic. The conventional approach uses synthetic, non-selective chemical pesticides and is the most frequently implemented. IPM utilises lower impact environmental approaches, such as restricted pesticide application and pheromones that disrupt mating in pests. Finally, the organic approach also uses mating-disruption pheromones as well as biological insecticides, e.g. viruses that only affect certain pests.

Spiders play an important role in an **ecosystem** as natural pest controllers. They are also good indicators of habitat quality because they are generalist predators, present in most ecosystems, and fill many ecological niches. Many pesticides can directly and indirectly affect organisms other than the targeted pests, including spiders.

To see how ground (epigeal) spiders are affected by different orchard management strategies, researchers sampled 597 spiders using pit traps in 19 orchards in southeast France. The sampling took place in 2009 and 2010 in 19 orchards — five under each of the three management types, and four abandoned orchards used as controls. The researchers measured the abundance and number of spider species in each orchard, and also carried out a trait-based assessment to see how pesticides affected the individual traits of those species in each area.

The study found the highest abundance (number of spiders per species) and diversity of spider species in the abandoned orchards, which were free of all human interaction. There was no difference in abundance between the organic, IPM or conventional approach.

However, organic orchards contained the highest levels of species diversity and distribution of spiders, while IPM and conventionally managed orchards had similarly lower levels. The researchers note that the difference in pesticide use may not have been great enough to show measurable effects.

The five traits measured were body size, ability to colonise a new area, feeding strategy, overwintering type, and maternal care. These traits were selected because they pertain to important ecological functions. In addition to being directly toxic to spiders, pesticides can indirectly impact spiders by negatively affecting their prey. A lack of prey can influence spider eating habits and therefore body size, ability to reproduce, dispersal patterns and recovery of species depletion. This also impacts the structure of orchards' spider communities.

Again, when comparing the three strategies, species found in the organic orchards had larger bodies and low dispersal abilities (only 5–7% of the species were able to disperse). A prime dispersal ability in these spiders is through aeronauts, where spiders shoot thin spindles of web into the air and are carried to a new habitat by the wind. Smaller bodies and high dispersal abilities (43–63%) were found in IPM and conventional orchards.

Continued on next page.



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To the authors' knowledge, this is the first study using this trait-based approach to test the effects of different orchard management practices on spider communities. They suggest this method is extremely useful in identifying the subtle yet significant effects of intensive agriculture, which may include the loss of biodiversity and species' behavioural traits.

Additionally, the researchers were able to identify several epigeal spider species as bioindicator species. These included seven in abandoned orchards, two species in organic orchards, and one in conventional orchards. These species may be useful to indicate the overall quality of an environment under the impact of different management practices.

