Chemical signals coordinate the dispersal of a plant-parasitic nematode with the metamorphosis of its vector beetle

With the support by the National Natural Science Foundation of China and the Chinese Academy of Sciences, Prof. Sun Jianghua (**孙江华**), Zou Zhen and Zhao Lilin et al. at the State Key Laboratory of Integrated Management of Pest Insects and Rodents, Institute of Zoology, Chinese Academy of Sciences, uncovered that ascarosides coordinate the dispersal of a plant-parasitic nematode with the metamorphosis of its vector beetle, which was published in *Nature Communications* (2016, DOI:10.1038/ncomms12341).

Insect vectors are required for the transmission of many species of parasitic nematodes, but the mechanisms by which the vectors and nematodes coordinate their life cycles are poorly understood. Here, we report that ascarosides, an evolutionarily conserved family of nematode pheromones, are produced by its vector beetle. Many nematode species use the ascarosides to control their development, aggregation, and olfactory plasticity. Our report shows that ascarosides are produced by animals other than nematodes and may have a much broader role in animal-animal chemical communication than was previously thought. We demonstrate that ascarosides mediate interspecific interactions between the plant-parasitic pinewood nematode (PWN), *Bursaphelenchus xylophilus*, and its vector *Monochamus alternatus*.

Pine wilt disease (PWD), which is caused by PWN, has devastated millions of hectares of pine forests in parts of Asia and Europe and has been placed under global quarantine. PWN is transported to host pine trees by its insect vector, the Monochamus beetle, during the summer. Inside the pine tree, the nematode develops rapidly through four larval stages (L_1—L_4) to the reproductive adult and weakens the pine tree host. Monochamus beetles lay eggs on the weakened pine tree in autumn, and the resulting beetle larvae develop within the pine tree. However, under unfavourable conditions such as low food and temperature in the winter, the nematode enters the dispersal phase of its life cycle, by molting from L_2 into dispersal juveniles (L_{III}). During the following spring, L_{III} are attracted to the beetle larvae and aggregate around their pupal chambers. Once the beetle larvae become late pupae or early adults, the L_{III} larvae are induced to develop into fourth-stage dispersal juveniles (L_{IV}). These L_{IV} then enter the tracheal system of the beetle for transport to a new pine tree host.

Chemical signals play a key role in mediating interspecific interactions between PWN, its vector beetle and the pine tree hosts. Our previous work has shown that the beetle facilitates the development and spread of PWN (*Curr. Biol.* 23, 2038—2043, 2013; *Ecology* 94, 2817—2826, 2013; *Trends Parasitol.* 30, 299—308, 2014). Here they demonstrate that ascarosides are used to coordinate the development and behavior of PWN and its vector beetle. During the winter, ascarosides produced by the beetle at low temperatures help to maintain the beetle in the larval stage. In the spring, the nematode L_{III} larvae aggregate around the beetle larvae and produce specific ascarosides, which promote the metamorphosis of the beetle. Once the nematode develops into the dispersal L_{IV} stage, specific ascarosides secreted by the beetle attract the nematodes, potentially facilitating their movement into the beetle trachea for transport to the next pine tree host. Their results suggest that the ascarosides promote the spread of an invasive nematode-beetle vector complex. This knowledge could potentially enable more effective approaches to disrupting the development of PWN and its vector beetle, as well as the transmission of PWN by the beetle to new pine tree hosts.

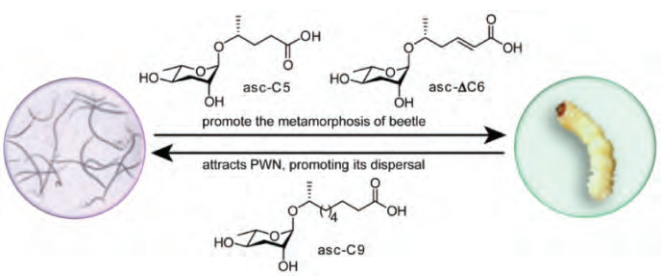

Figure Ascarosides mediate the interaction between the pinewood nematode and its vector.