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PRESS RELEASE (2026/08/07)

Natural insecticide made by nanoemulsification of compounds found in garlic and spearmint found to be effective on adzuki bean beetles with low non-target impacts

Researchers develop a new environmentally friendly insecticide against the adzuki bean beetle—a known legume pest—from nanoemulsions of diallyl disulfide and carvone

Fukuoka, Japan—In an effort to develop more environmentally friendly alternatives to synthetic insecticides, researchers from Kyushu University have developed and tested a new insecticide made from compounds derived from garlic and spearmint.

In their paper published in *Ecotoxicology and Environmental Safety*, the research team processed diallyl disulfide, an organosulfur compound derived from garlic, and R-carvone, a monoterpenoid from spearmint, into an emulsion of nanometer-sized droplets of oil-in-water. These nanoemulsions were then tested on a known legume pest called the adzuki bean beetle. They found that the insecticidal efficacy of the individual compounds was enhanced, and mixing the two compounds together added to their toxicity towards the pest.

"When people hear the term "insecticide," they often think of synthetic chemicals that could be damaging to people and the environment. However, plants have evolved to produce compounds with potent insecticidal activity as a means of defending themselves from insect attack," explains Urvashi Sahu, a JSPS postdoctoral fellow at Kyushu University's Faculty of Agriculture and first author of the study. "In our research, we aim to develop ways to enhance the effect of natural insecticides."

The team decided to utilize nanotechnology to develop a natural insecticide against the adzuki bean beetle *Callosobruchus chinensis*, a legume pest that causes significant postharvest losses. The compounds they turned to were diallyl disulfide (DDS) and R-carvone (Car), the active compounds found in garlic and spearmint, respectively. These are the compounds that give the plants their distinct odors.

Ultrasonication was used to emulsify both DDS and Car into oil-in-water droplets about 50-60 nm in diameter. These nanoemulsions were then placed in a container with adzuki bean beetles to test their insecticidal efficacy.

"We found that processing the compounds into nanoemulsions greatly enhanced their toxicity against the beetles. DDS showed a 30.5% increase in toxicity and Car toxicity increased by 8.2%," continues Sahu.

Furthermore, the nanoemulsions had relatively low toxicity to *Anisopteromalus calandrae*, a known parasitic wasp that infects adzuki bean beetle larvae. Specifically, when half of the adzuki bean beetles die from the pesticide, only up to 22% of the wasps perished. This means that using both the nanoemulsions and parasitoid wasps can potentially enhance the effectiveness of pest control. The nanoemulsions were also safe on adzuki seeds and enhanced their root growth. No residual compounds were detected on the seeds themselves.

The next step for the team is to verify the efficacy of their new nanoemulsion under real-world environmental conditions and at large-scale grain and legume storage facilities. They

also hope to elucidate the mechanism of how these nanoemulsions work to control the lifespan of the adzuki bean beetle.

"We will be looking into whether our insecticide can be effective on other pests. Our goal is to commercialize this technology as a sustainable, environmentally friendly alternative to pest control and management," concludes Professor Midori Tuda, who led the research team. "Applying new technologies to compounds already found in nature holds massive potential for the future of science, agriculture, and humanity."

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For more information about this research, see " Enhanced toxicity of diallyl disulfide and carvone nanoemulsions against a stored bean pest and their nontarget effects on its parasitoid and seed viability," Urvashi Sahu, Eman Ahmed Mohamed Helmy, Midori Tuda, *Ecotoxicology and Environmental Safety*, https://doi.org/10.1016/j.ecoenv.2026.120374

About Kyushu University

Founded in 1911, Kyushu University is one of Japan's leading research-oriented institutions of higher education, consistently ranking as one of the top ten Japanese universities in the Times Higher Education World University Rankings and the QS World Rankings. Located in Fukuoka, on the island of Kyushu—the most southwestern of Japan's four main islands—Kyushu U sits in a coastal metropolis frequently ranked among the world's most livable cities and historically known as Japan's gateway to Asia. Its multiple campuses are home to around 19,000 students and 8,000 faculty and staff. Through its VISION 2030, Kyushu U will "drive social change with integrative knowledge." By fusing the spectrum of knowledge, from the humanities and arts to engineering and medical sciences, Kyushu U will strengthen its research in the key areas of decarbonization, medicine and health, and environment and food, to tackle society's most pressing issues.

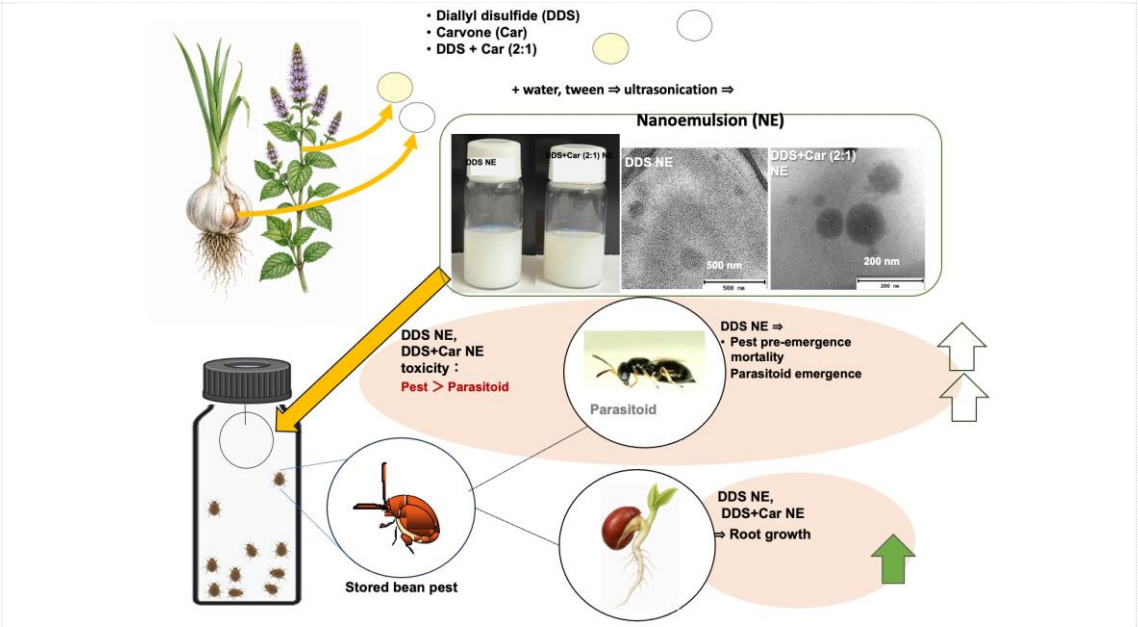

Fig. 1. Graphical abstract of the research. Diallyl disulfide (DDS) is an organosulfur compound derived from garlic and (R)-carvone (Car) is a monoterpenoid derived from spearmint. These compounds were processed into oil-in-water nanoemulsions via ultrasonication. The nanoemulsions exhibited high toxicity and improved insecticidal efficacy against the adzuki bean beetle. Additionally, the nanoemulsions of both only DDS and its mixture with Car exhibited relatively low toxicity against the Anisopteromalus calandrae, a parasitic wasp that is the natural enemy of adzuki bean beetle. (Midori Tuda/Kyushu University)

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