The rapid evolution of insecticide resistance in insect pest populations can make chemical controls ineffective and unsustainable, so effective alternative management strategies for these insect pests are needed. To address this, ARS is researching organic biopesticides and encasing the biopesticides with nanoparticle-based formulations and generated the following accomplishments in 2022.
Two natural substances are excellent insecticides against spotted wing drosophila. Spotted winged drosophila (SWD) is an intractable pest of small fruit crops and is effectively controlled in conventional agriculture by powerful synthetic insecticides. In contrast, organic berry producers have only two control options, but the effectiveness of these products varies considerably. ARS researchers in Poplarville, Mississippi, and Miami, Florida, and University of Hawaii cooperators identified two compounds from pennyroyal and basil plants that were neurotoxic to SWD and that killed more than 60 percent of eggs and adult flies in blueberry fields. Laboratory tests revealed these compounds eliminated SWD reproduction at concentrations of 0.5 percent. These monoterpene substances are readily available and are being formulated as a new organically certified biopesticide targeting small-bodied crop pests. (NP 305)

Nanoparticle formulations enhance biopesticide efficacy. Environmentally friendly biopesticides such as entomopathogenic (insect-killing) nematodes and fungi can control various economically important insect pests such as pecan weevil and peachtree borer. However, the efficacy of these biopesticides can be limited due to their sensitivity to ultraviolet radiation, so it is critical to develop new formulations that protect the biopesticide organisms from environmental stress. ARS researchers in Byron, Georgia, have a research agreement with the Agricultural Research Organization Volcani Center in Israel that is directed toward developing novel formulations for biopesticides based on nanotechnology. ARS and Israeli partners discovered that nanoparticle-based formulations protect biopesticides from ultraviolet radiation and thereby increase pest control efficacy. This technology can lead to improved sustainability in pest management practices. A patent application is being submitted based on the discovery. (NP 304)

New integrated pest management tactics for stored product insects with phosphine resistance. The abundance and range of stored product insect pests with phosphine resistance are increasing around the world. Phosphine is one of the most commonly used fumigants in large warehouses and food facilities for insect control, and the emergence of resistance threatens its efficacy, which has become a key stakeholder concern. Long-lasting insecticide-incorporated netting (LLIN) and packing material containing insecticides have been effective against several species of stored product insects. ARS researchers in Manhattan, Kansas, evaluated the efficacy of LLIN and packaging materials containing four different active ingredients (deltamethrin, permethrin, indoxacarb, and dinotefuran) against phosphine-resistant populations of lesser grain borer and red flour beetle. Overall, all compounds caused significant mortality in phosphine-resistant strains of both species, with the exception of indoxacarb for red flour beetle. Using bags and netting impregnated with insecticides provides new tools to prevent and reduce infestations of stored product insects, including those that have evolved resistance to phosphine. (NP 304)

Development of lettuce varieties with resistance to leafminers, corky root, and downy mildew. Leafminers, corky root, and downy mildew are major pests and diseases of lettuce, and the most cost-effective controls are achieved through resistant cultivars. ARS researchers in Salinas, California, developed and released two green leaf, one red leaf, and two romaine lettuce varieties with resistance to these pests and diseases. The varieties may be used for commercial production and can be used by other public and private breeders as sources of resistance in developing new lettuce cultivars. (NP 301)

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