United States Department Of Agriculture
Agricultural Research Service

AFRS Fruit Update



Recent research at the
Appalachian Fruit Research Station
Kearneysville, WV

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Identification of an Effective Mating Disruption Formulation for Dogwood Borer

The dogwood borer, *Synanthedon scitula* (Harris), is an important wood boring pest of apple in eastern North America. The increased severity of dogwood borer infestations in apple orchards is related to the introduction of dwarfing rootstocks. These rootstocks promote the formation of burr knots on exposed portions of the rootstock and on the trunk and scaffold limbs. Burr knots are an excellent food resource for developing larvae and serve as the primary point of infestation of apple trees. Larval feeding in burr knots does not necessarily affect the growth and vigor of apple trees, but their mining outward from burr knots into

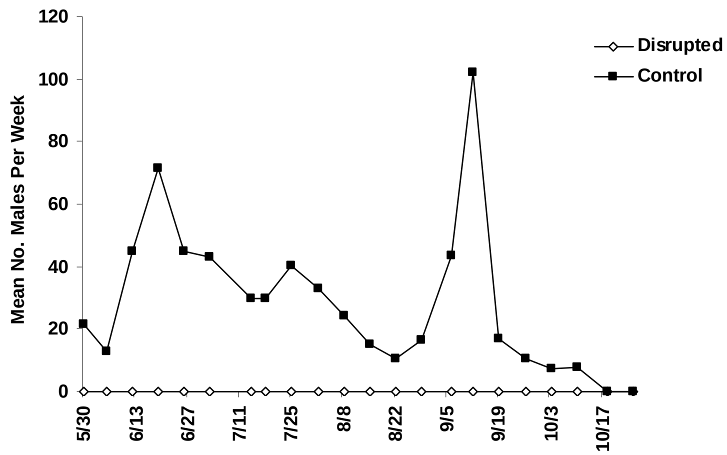
vascular tissue can ultimately cause tree decline and death. Trees of susceptible rootstock-cultivar combinations such as 'Gala' on EMLA 26 are susceptible to dogwood borer infestation soon after planting and the majority of trees often become infested within the first several years after planting

The organophosphate insecticide chlorpyrifos has provided the most consistent and highest level of control of dogwood borer in apple orchards. A single trunk-drench application at half-inch green or petal fall provided season-long control in New York orchards. However, the review of tolerances for organophosphate pesticides under the 1996 Food Quality Protection Act has resulted in cancellations and increased restrictions on the use of chlorpyrifos, highlighting the importance of developing alternative management tactics for this pest.

Dr. Tracy Leskey at AFRS and Drs. Aijun Zhang (USDA-ARS, Beltsville, MD), Dr. Chris Bergh (Virginia Tech.) and Dr. Jim Walgenbach (North Carolina State) collaborated on identification of the sex pheromone of dogwood borer and documented its attractiveness and species specificity. Lures formulated with this new pheromone blend outperformed commercially available lures for dogwood borer, capturing up to ~400x more males.

The identification of this pheromone also provides the opportunity to explore mating disruption as an alternative management tool for dogwood borer. Mating disruption has proven successful against two closely related species of the dogwood borer, the lesser peachtree borer, *S. pictipes* (Grote & Robinson) and peachtree borer, *S. exitoisa* (Say).

Recently, Leskey and her colleagues were funded by the USDA-CSREES Pest Management Alternatives Program to identify the most effective mating disruption formulation and develop an improved synthetic pathway for producing the main component of the dogwood borer sex pheromone. In most cases, mating disruption blends for moths are based on the sex pheromone produced by the female moth. However, Leskey and her colleagues demonstrated that compounds not present in the sex pheromone of dogwood borer also could be used to disrupt mate-finding by male dogwood borer moths, namely an antagonistic compound that is the main component of the sex pheromone of the lesser peachtree borer. In field trials conducted in West Virginia, North Carolina and Virginia, deploying an antagonist-based disruption blend (Isomate® LPTB dispensers, Pacific Biocontrol Products), resulted in over 99% of male mate-finding being disrupted. Currently Leskey and her colleagues are conducting a two-year study comparing mating disruption formulations based on the antagonist and on the sex pheromone of dogwood borer in commercial apple orchards in West Virginia, North Carolina, and Virginia in order to identify the most effective formulation.



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Do sources of natural insect resistance exist in wild apple sources?

In the United States, apple trees can face attack from up to 30-40 insect pest species in a typical growing season. This level of insect inundation has historically required the use of large amounts of chemical insecticides by apple growers. However, research efforts are underway to develop new apple varieties that are naturally resistant to a number of insect pests. Dr. Clayton Myers and cooperators at Cornell University and USDA's Plant Genetic Resources Unit (PGRU) in Geneva, New York, have made significant progress in the screening of apple germplasm from around the world for sources of natural resistant to attack from major fruit feeding insect pests. It is hoped that such sources could be used by breeders and/or geneticists to introduce pest resistance genes (via breeding or genetic modification) into commercially appealing apple varieties, resulting in a decreased reliance upon chemical insecticides.

USDA houses an important repository of apple genetic diversity at its PGRU facility in Geneva, NY. Collections of apple and crabapple trees from around the world are held and maintained here, for usage by researchers. PGRU's collections include most of the known commercial apple varieties and hybrids developed for production, as well as exotic specimens of over 30 different *Malus* species found around the world. Using these collections, Dr. Myers evaluates material for it's susceptibility to attack from apple pests such as codling moth, apple maggot (Myers et al. 2008), and plum curculio (Myers et al. 2007).

USDA-PGRU 'core' *Malus* germplasm collection, a replicated block of domestic and exotic apple accessions utilized by researchers worldwide

Preliminary studies focused on domestic apple hybrids that could be evaluated for commercial usage. 'E36-7,' a scab-resistant apply hybrid developed from the Purdue-Rutgers-Illinois (PRI) breeding program was found to be significantly resistant to feeding of apple maggot larvae, in comparison to a number of other susceptible hybrids, and the known susceptible variety 'McIntosh' (Myers et al. 2008).

Beyond domestic cultivars, a large number of exotic crabapple types were also screened for pest resistance. Among the more promising findings are two crabapple types that appear to be significantly resistant to attack from codling moth larvae. While crabapples are less desirable as a source of resistance (due to the difficulty in segregating the genes for resistance from the genes that confer a number of other undesirable fruit characteristics), researchers are now conducting studies to characterize the specific mechanisms of the observed resistance. This will help scientists to eventually determine if such resistance can be transferred to commercial varieties in a way that is compatible with production of consistent, appealing, high-quality fruit.

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Diversifying Orchards for Biocontrol

Pesticides for controlling insect pests in orchards are getting more expensive. The market is also demanding lower levels of pesticide residue on fruit. For these reasons and to maintain the well-earned image of good environmental stewards, there is an increasing desire for alternatives to chemical insecticides. Biological control of insects is a tool available for controlling many insect pests without pesticides. Biological control is also a key tool in sustainable fruit management because it is based on ecological stability of the orchard and can be self-maintained with a little effort.

Dr. Mark Brown, with colleagues at the Appalachian Fruit Research Station in Kearneysville, WV, has been conducting research on methods for increasing levels of biological control in apple and peach orchards. He has been working with what is called conservation biological control, which increases the effectiveness of naturally occurring insects that feed on pests. Insect predators and parasitoids are abundant in orchards and are capable of destroying a large number of pest insects. To maximize their effectiveness we must provide food and shelter for them. These natural enemies do require food other than the pest for optimal performance. They also require shelter from harsh environmental conditions. In other words, they are working for us to help produce high quality fruit and it is our responsibility to take care of them.

Dr. Brown has been working on how we can best provide for these natural enemies. He has found that by adding companion plants (buckwheat, dill and marigold planted to provide pollen and nectar specifically for natural enemies) the need for insecticides is reduced without an increase in fruit injury from insects. Not only do these plants provide extra food for the natural enemies but the reduction in insecticides reduces exposure to toxic chemicals. Peach and cherry trees also provide nectar for natural enemies with nectar glands on the base of leaf blades. Natural enemies are able to feed on this nectar and be more effective at controlling pests on peach and on nearby apple trees. By mixing peaches or cherry trees in the apple orchard, such as by mixing small blocks of the different fruit trees or alternating several rows of each, food can be provided to increase the effectiveness of pest control by the enemies.

Another method for diversifying the orchard is to add a compost mulch under the fruit trees. The compost is a benefit to soil health, can provide some weed control, add nutrients and increase biological control. Diversity is increased by adding organic matter to the soil which increases the diversity of insects that feed on organic matter and their predators. Many of our orchard pests (e.g., codling moth, plum curculio, apple maggot fly, rosy apple aphid, woolly apple aphid) spend a portion of their life cycle on or in the soil and are, therefore, exposed to the predators on the ground.

Diversifying the orchard is a good way to increase biological control of insect pests and allow us to reduce insecticide input into the orchard. Biological control cannot provide effective control of all our pests but combined with other methods such as behavioral management and insect resistant fruit trees (both of which are being investigated by colleagues at the Appalachian Fruit Research Station) we can reduce the need for many of the insecticides currently being used.

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