

Each year throughout the world, scientists are looking for natural ways to curb weeds, diseases and insect pests that attack our beneficial plants that feed, clothe and house us. They look for non-synthetic naturally produced substances or organisms that are natural enemies of the pests. These methods encompass just one branch of the study of biotechnology.

Damage by more than 4,500 exotic or invasive species costs an estimated \$130 billion each year in the United States. For example, Giant reed (*Arundo donax*) and saltcedar (*Tamarix* sp.) have displaced native willow and cottonwood stands along waterways throughout the West which clog them up reducing waterflow.

Pink hibiscus mealybug (*Maconellicoccus hirsutus*) was recently discovered in Southern California and has caused significant damage in the Caribbean basin. It attacks more than 200 plant varieties, including bean, citrus, cotton, corn, cucumber, grape, hibiscus, pumpkin, lettuce, peach and pear.

All three pests are native to the Indian subcontinent. Scientists with ARS in Albany, Calif., and Montpellier, France, and a collaborator from the University of California in Berkeley spent three weeks in India and Nepal searching for insects and pathogens that might serve as biological control agents against the pests in the United States.

The team collected 14 potential agents that were sent to the quarantine facility at the ARS European Biological Control Laboratory in Montpellier, France for further evaluation. They also set up collaborations with scientists in India and Nepal to continue research on these pests.

Annual morning-glories and other broad-leaved weeds could meet their match in a novel bioherbicide that includes weak or nonvirulent fungi and an oil emulsion, Agricultural Research Service (ARS) studies suggest.

Use of the bioherbicide could offer a nature-based alternative to conventional chemical controls--and the risks associated with applying them, such as drift beyond crop fields and groundwater contamination. One bioherbicide ingredient is the saprophytic fungus *Myrothecium verrucaria*. In nature, it survives by absorbing nutrients from decaying plant matter. When mixed with oil, however, it can kill many common dicot weed species, including annual morningglories, bermudagrass, pigweed and bindweed.

In early greenhouse studies, ARS researcher MingYang showed that oil serves as both an emulsifier that retains moisture and a synergist that enables the fungus to kill weeds. Neither *M. verrucaria* nor oil alone will damage plants, so natural movement of the fungus to crops or other nontarget plants isn't likely.

In test plots in Maryland, Louisiana, Mexico and France, the fungus killed or damaged the weeds as effectively as the herbicides atrazine which is a very persistent herbicide in our environment and 2,4-D. In June 2000 trials on Houma, La., sugarcane plots, about 95 percent of smallflower morningglory plants sprayed with the fungus died 4 days later, versus 100 percent for those treated with atrazine. Rex Millhollon, a collaborating scientist at ARS' Sugarcane Research Station in Houma, conducted the trials.

The ARS team began experimenting with *M. verrucaria* in 1997. In 1998, they received a patent covering use of weak or nonvirulent fungi in combination with an adjuvant and oil emulsion as a broad-spectrum bioherbicide. The technology is now available for licensing.

Before commercialization is possible, however, scientists must first determine whether this strain of the fungus produces metabolic byproducts called trichothecenes that are dangerous to humans and other animals. Finding non-harmful biologically occurring pesticides could reduce use of synthetic pesticides such as atrazine and result in products more friendly to our environment.