

2007

CALIFORNIA REPORT

EXOTIC/INVASIVE PESTS AND DISEASES RESEARCH PROGRAM



UNIVERSITY OF CALIFORNIA
AGRICULTURE AND NATURAL RESOURCES



UNIVERSITY OF CALIFORNIA

INVASIVE SPECIES ARE ENORMOUS THREAT TO PLANT AND ANIMAL LIFE

Invasive species are intercepted every year at international ports of entry into the United States.

The UC Exotic/Invasive Pests and Diseases Research Program (EPDRP) funds projects for prevention, early detection, and rapid development of control or eradication measures for invasive insects, weeds, crustaceans, plant diseases, and other pests.

Exotic pest damage to California agriculture alone is estimated at \$3 billion annually and climbing. The glassy-winged sharpshooter, red imported fire ant, and sudden oak death are just some of the exotic pests and diseases of great concern to our state.

These exotic pests can jeopardize our country in numerous ways, from public health to our native ecosystems. And plant pests and diseases threaten important domestic industries that employ thousands and are vital to state economies. These invaders can wipe out harvests, choke waterways, and destroy the landscape, inviting wildfires. Even some wildlife extinctions can be blamed on invasive weeds, predators, or pathogens.

UC Davis, UC Berkeley, UC Riverside, California Department of Food and Agriculture, Marine Science Institute at UC Santa Barbara, USDA-Agricultural Research Service, The Nature Conservancy, and the U.S. Forest Service are just some of the organizations participating in this research grant program.

Participating scientists represent such disciplines as entomology, plant pathology, medicine, evolution and ecology, plant sciences, and insect biology.

This collaboration between the UC Statewide IPM Program and the UC Riverside Center for Invasive Species Research has garnered success stories such as these:

- After testing various species, scientists found a parasitoid that can control the spotted gum psyllid without destroying other beneficial species.
- Biologists have found a way to nearly eliminate sabellid polychaetes, invasive pests in California abalone production and display facilities.
- An entomologist traveled to Florida in 2001 to consult with researchers about ways to prevent spread of Diaprepes root weevil to citrus groves and other crops in California. This foresight may have helped to minimize damage since the insect's recent arrival in southern California.

Since 2001, special research grants from USDA Cooperative State Research, Education, and Extension Service have provided \$9 million to support more than 100 innovative research and extension projects addressing exotic pests and invasive species in agricultural, urban, and natural landscapes.

There will be no call for new proposals for 2007–08 funding by the UC EPDRP since there is expected to be no more funding from USDA CSREES. However, funding commitments to all projects that began in 2005–06 or 2006–07 are assured, and program leaders are working to identify new sources of funds for this important research need.

FUNDING RESEARCH ON THESE EXOTIC PESTS AND INVASIVE SPECIES:

IN AGRICULTURAL ENVIRONMENTS

Avocado lace bug
Citrus leafminer
Corn leafhopper
Corn stunt
Cottony cushion scale
Diaprepes root weevil
Early and late watergrasses
False root knot nematode
Fusarium oxysporum
Rice blast
Ryegrasses
Verticillium wilt
Vine mealybug
Walnut aphid

IN NATURAL ENVIRONMENTS

Barb goatgrass
Batrachochytrium
Eurasian watermilfoil
Giant reed
Invasive marine species
Mediterranean annual grasses
Pitch canker
Sahara mustard
Sudden oak death
Water primrose
Wild pigs
Yellow starthistle

IN URBAN ENVIRONMENTS

Asian hackberry woolly aphid
Cerambycid beetles
Eucalyptus longhorned borer
Gray leaf spot
Mediterranean pine engraver
Redhaired bark beetle
Red imported fire ant
Spotted gum psyllid



SPOTLIGHT

RESEARCHERS STUDY

HOW FIRE ANTS SPREAD DURING MATING F

Scientists have calculated flight distances and are measuring weather conditions that occur during aerial swarms of the red imported fire ant in a step toward better predicting the insect's spread in California.

In the southeastern United States, massive fire ant colonies destroy crops, damage farm and electrical equipment, and hasten soil erosion. Humans and livestock are particularly vulnerable to the insect's stinging attacks.

Although the red imported fire ant is common in 12 southern states, it is new to California and now infests numerous residential and commercial areas in Orange, Riverside, Los Angeles, and to a lesser extent, San Bernardino and San Diego counties. The ant has also been found in almond orchards in the Central Valley. The spread of these ants has largely been a result of the introduction of infested plants and honeybee hives infested with fire ants from other states.

During the three-year project, University of California, Riverside entomologists Michael Rust and Les Greenberg learned how to tether the ants to flight mills and measure their flight duration and speed. "Once tethered to the arm of the flight mill, the ants fly in circles around a pivot point," explains Rust. "We can record

how long they fly and how long it takes them to move 360 degrees. Using the arm of the flight mill, we calculate the circumference of the circle it traces. From this, we learn the ant's flight distance."

//Once tethered to the arm of the flight mill, the ants fly in circles around a pivot point.//

Armed with this new information about fire ant flight distance, Rust and Greenberg then set out to determine weather conditions that occur during aerial swarms of the insect.

"Normally, in the southeastern United States, fire ant flights are triggered by warm weather, rainfall, and subsequent high humidity," says Rust. "Under California conditions, we have seen flight activity associated with irrigation. For example, in the Coachella Valley on almost any summer day, flight activity occurs at some locations after sprinklers turn off at large, infested golf courses or city parks. Mating swarms may be found near these large irrigated areas. Walking through these areas, we can see whether females are surfacing and preparing for flight."

"Rain is a precursor to fire ant flights. However, the queens wait for sun and blue sky before they'll fly," says Greenberg. "Also, they don't fly if it's windy. So, it's unlikely that fire ants will fly during or shortly after thunderstorms."

During the last year, researchers have perfected and extensively tested the device they need to study flight in fire ants. Rust and Greenberg recently took their equipment to Alabama for field trials with urban entomologist Art Appel and extension entomologist Fudd Graham from Auburn University. Auburn is in an area heavily

COVER PHOTOS:

Top: Citrus leafminer. Photographer unknown. Bottom Left: Red imported fire ant. Photo by Jack Kelly Clark. Bottom Right: Cottony cushion scale colony. Photo by Jack Kelly Clark.

LIGHTS

infested with fire ants where rain stimulates flights. Researchers want to know how the ant flights there differ from southern California where rainfall and humidity are severely limited.

Scientists used a 10-foot helium balloon packed with weather instruments to record temperature, humidity, and wind speed. They used a ground weather station to compare with the instruments on a tether. Large sticky traps were lifted with the balloon at 50-foot intervals along the tether. These triangular traps are about 2 feet long, and their inner surfaces are coated with a sticky material that traps the insects.

"This spring in Alabama we trapped our first flying fire ant in these traps. This is significant because right now there aren't any monitoring traps for fire ants," says Rust. With this experience, the researchers are designing improvements in the equipment for future trials in California.

With the balloon and weather equipment, Rust and Greenberg logged wind speed, temperature, humidity, and barometric pressure at the swarm's height, as well as conditions measured at various altitudes.

"These discoveries will help regulatory agencies to search for new infestations in particular areas based on weather and the influence it has on fire ant swarming, rather than randomly searching for new infestations," says Rust. "The ability to trap flying ants could also lead to the development of attractants that could be put into traps as a monitoring tool."

The UC Exotic/Invasive Pests and Diseases Research Program, a collaboration between the UC Statewide Integrated Pest Management Program and the UC Riverside Center for Invasive Species Research, sponsored this project. U.S. Department of Agriculture, Cooperative State Research, Education and Extension Service, funds the program.

To learn how to identify the red imported fire ant, visit www.ipm.ucdavis.edu.

California currently does not have a program aimed at eradicating the red imported fire ant within the state. In Orange County and the Coachella Valley, homeowners should contact their local Vector Control agency for advice on control measures. In Los Angeles and San Diego counties, the local agricultural commissioner can be contacted for advice. In other locations, any suspected infestation should be reported using the statewide toll-free number that has been set up by the California Department of Food and Agriculture for this purpose (1-888-4fireant). There is also an informative Web site, <http://www.fireant.ca.gov>. Once contacted, state personnel will determine if the ants are red imported fire ants, and if so, will apply approved treatments free of cost or recommend a course of action.



UC Riverside Entomologist Michael Rust prepares a sticky trap for flight.
Photographer unknown

Agricultural Systems

USING MOLECULAR MARKERS TO TRACE HERBICIDE RESISTANCE IN EARLY AND LATE WATERGRASSES IN RICE

M. A. JASINIUK AND A. J. FISCHER,
PLANT SCIENCES, UC DAVIS

YEAR 3 OF 3

Researchers are mapping genes in early and late watergrasses to identify genes that cause resistance to three major herbicides used to control these weeds. This genetic information can help growers decide if they should focus on preventing seed movement or reducing the intensity of herbicide applications for particular weed populations. Knowledge of the genetic factors that affect the selection and spread of resistance within and among fields is essential for the development of strategies to manage watergrass invasions.

IMPACTS OF HYPERPARASITIDS AND PREDATORS ON BIOLOGICAL CONTROL OF WALNUT APHID

N. J. MILLS, INSECT BIOLOGY, UC BERKELEY

YEAR 3 OF 3

Scientists are studying the role of hyperparasitoids and predators in the recent failure of a parasite that previously provided long-term control of the walnut aphid. Findings show high levels of hyperparasitism (a parasite living on another parasite) that compromise the ability of the walnut aphid parasite to provide effective control. Laboratory testing shows that walnut aphid parasite females spend more time in patches of greater aphid abundance when hyperparasitoids are present but with no significant increase in reproduction. This behavioral response is unusual because females waste time and eggs with no significant increase in lifetime reproduction. The aphid parasite may be confused by the presence of hyperparasitoids and responds inadequately by treating them as a competitor.

MANAGING CORN LEAFHOPPER AND CORN STUNT DISEASE

C. G. SUMMERS, ENTOMOLOGY, UC DAVIS

YEAR 2 OF 2

Research identified winter cereal species that serve as bridge hosts to help carry adult leafhoppers through the winter. The study indicates that 3rd, 4th, and 5th instar nymphs can complete their development on winter cereals and that these plants may serve as oviposition hosts. Research shows that a seedborne pathogen causes corn stunt disease. Planting successive corn crops is a dangerous practice because the large number of spring volunteer corn plants may carry the infective agent, a spiroplasma, and serve as a ready in-field source of disease inoculum.



Adult corn leafhopper. Photo by Jack Kelly Clark.

DETECTING *FUSARIUM OXYSPORUM* IN COTTON SEED AND SOIL

R. M. DAVIS, PLANT PATHOLOGY, UC DAVIS
YEAR 2 OF 3

Researchers have developed a race-specific detection method for *Fusarium oxysporum* in cotton seed and soil to keep out an exotic virulent race from Australia and contain Race 4, which was recently identified in California. Applying this technology to seed and soil samples will give growers a more rapid diagnostic tool to help manage *Fusarium oxysporum* races found in infested fields.

CHARACTERIZING GLYPHOSATE RESISTANCE IN RYEGRASSES

M. A. JASIENIUK, PLANT SCIENCES, UC DAVIS
YEAR 2 OF 3

Weed populations with different mechanisms of herbicide resistance may respond differently to methods used to manage resistance and prevent spread of resistance genes. Preliminary genetic studies show rigid ryegrass, Italian ryegrass, and perennial ryegrass all readily hybridize and likely transfer glyphosate-resistance genes among themselves. Research results will help to develop strategies to slow further resistance and manage existing resistant populations.

TRAINING TO IDENTIFY PREDACEOUS MITES FOUND IN CALIFORNIA

E. E. GRAFTON-CARDWELL, ENTOMOLOGY, UC RIVERSIDE
YEAR 2 OF 3

Field surveys have been used to identify which species of predatory mites are most common in California agricultural crops. Researchers are developing an identification key to separate and characterize common predatory mites found in different cropping systems. Use of the key to identify predator mites can help with pest management decisions and development of IPM programs that use predatory mites to suppress pest populations and lessen insecticide use.

ECONOMIC INJURY LEVEL FOR COTTONY CUSHION SCALE

E. E. GRAFTON-CARDWELL AND J. T. TRUMBULL,
ENTOMOLOGY, UC RIVERSIDE
YEAR 2 OF 2

The study focuses on determining how many cottony cushion scales it takes to reduce crop yield in citrus. Preliminary results indicate that the economic threshold is more than four per branch. This knowledge will help growers avoid unnecessary insecticide applications for controlling cottony cushion scale by spraying only when a critical density of these pests is observed on branches.

RESPONSE OF RICE BLAST TO A RESISTANT RICE CULTIVAR

T. R. GORDON, PLANT PATHOLOGY, UC DAVIS
YEAR 2 OF 3

Researchers surveyed rice fields and collected plants that show rice blast symptoms. They compared the range of infection found in these populations to infection present at the outset of the infestation in the mid-1990s. Preliminary results show that the range of infection has increased over the last 10 years. As yet, no samples of rice blast have been found to cause significant damage to a recently released rice cultivar that is resistant to rice blast.

MANAGING AVOCADO LACE BUG IN CALIFORNIA

M. S. HODDLE, J. G. MORSE, AND R. STOUTHAMER,
ENTOMOLOGY, UC RIVERSIDE
YEAR 2 OF 3

After a year of monitoring six sampling sites in San Diego County, researchers observed that the highest densities of adult avocado lace bugs occurred between August and December, with the peak occurring in October. The most promising commercially-available natural enemy for avocado lace bugs is green lacewing larvae. Pesticides compatible with this natural enemy have been identified as part of a developing IPM program for this pest.



Avocado lace bug. Photographer unknown.

ORIGIN AND DIVERSITY OF THE CAUSE OF RICE BLAST AND GRAY LEAF SPOT OF TURF

F. WONG, PLANT PATHOLOGY, UC RIVERSIDE
YEAR 1 OF 2

Studies indicate that the emergence of gray leaf spot on perennial ryegrass is likely a result of importation from the eastern United States while that found on kikuyugrass appears to have already been established here and may have arisen due to changes in turf management practices.

DETERMINING SUSCEPTIBILITY TO SELECT INSECTICIDES FOR VINE MEALYBUG CONTROL

C. GISPERT, UCCE, RIVERSIDE CO.
YEAR 1 OF 1

This study demonstrated the lethal effects of selective insecticides against various vine mealybug populations from Coachella and San Joaquin valleys. Researchers investigated the toxicological effects of chlorpyrifos, dimethoate, methomyl, buprofezin, and imidacloprid against vine mealybug. These data will help to determine the relative toxicity of insecticides that are effective at various life stages of the insect. Further tests against other vine mealybug populations will help determine if reduced efficacy of certain insecticides is related to resistance of the pest to these pesticides.

INVESTIGATING NONHOST/HOST RESISTANCE TO VIRUSES IN CITRUS AND TOMATO

J. NG, PLANT PATHOLOGY, UC RIVERSIDE
YEAR 1 OF 2

Researchers are identifying and studying plant genes that create resistance to aphid-transmitted virus diseases in important subtropical plants. The discovery of previously unidentified antiviral genes in citrus and tomatoes may benefit plant breeders seeking to enhance disease resistance in crop plants through selective breeding efforts.

ABIOTIC ROOT STRESS AND CALCIUM IN RELATION TO SUSCEPTIBILITY OF ORNAMENTAL HOSTS TO SUDDEN OAK DEATH

R. M. BOSTOCK, PLANT PATHOLOGY, UC DAVIS
YEAR 1 OF 1

Research shows that sudden oak death can directly infect roots and move systemically in rhododendron and viburnum to involve stem and leaf tissue. Manipulating calcium levels to manage the sudden oak death pathogen under commercial growing conditions may not be effective for minimizing disease development in rhododendron and viburnum, two plants that have been implicated in moving the pathogen.

CHARACTERIZING INVASIVE ISOLATES OF VERTICILLIUM WILT IN LETTUCE

K. V. SUBBARAO, PLANT PATHOLOGY, UC DAVIS
YEAR 1 OF 2

By characterizing the genetic variation and host range of *Verticillium* wilt in lettuce, researchers can determine whether these disease races developed from local populations or were introduced from somewhere else. Results will help to determine which genotypes of *Verticillium* wilt are common in lettuce production areas, help to identify its host range, and may be used by plant breeders to develop resistant lettuce varieties.



Verticillium wilt in lettuce. Photo by K. V. Subbarao.

PROTECTING AGRICULTURE FROM FALSE ROOT KNOT NEMATODE INVASION

J. BALDWIN, NEMATOLOGY, UC RIVERSIDE
YEAR 1 OF 3

Scientists collected samples of false root knot nematode from Mexico because this area poses the greatest threat for introducing this pest into California. Researchers are studying the biology of Mexican samples and identifying and mapping nematode genes. Results indicate that samples of false root knot nematode from Mexico belong to a different group than those found in the western U.S. or South America. After a detailed analysis of genetic diversity, researchers hope to provide a diagnostic tool to help prevent introduction and spread of false root knot nematode.

ENTOMOPATHOGENIC NEMATODES FOR CONTROL OF DIAPREPES ROOT WEEVIL

E. LEWIS AND H. K. KAYA, NEMATOLOGY, UC DAVIS
YEAR 1 OF 2

Research will assess the suitability of soils from major citrus growing regions of California for using entomopathogenic nematodes as biological control agents against *Diaprepes* root weevil. Scientists will find where entomopathogenic nematodes are effective against this pest based on location and types of soil.

IS CITRUS LEAFMINER AN ECONOMIC PEST OF BEARING CITRUS?

R. F. LUCK, J. G. MORSE, AND J. M. HERATY, ENTOMOLOGY, UC RIVERSIDE

YEAR 1 OF 3

Researchers have developed a citrus IPM program that exploits a complex of natural enemies, both indigenous and introduced, to suppress populations of several pest species below levels of economic concern. With the addition of citrus leafminer, scientists are trying to determine to what degree naturally occurring parasitoids control citrus leafminer and whether more natural enemies need to be imported and released in California to control this new pest.

Natural Systems

NITROGEN DEPOSITION AND SOIL TYPE IMPACTS ON INVASIVE ANNUALS IN THE MOJAVE DESERT

E. B. ALLEN, BOTANY AND PLANT SCIENCES, UC RIVERSIDE

YEAR 3 OF 3

Soil studies showed that elevated nitrogen from air pollution increased the rate of nitrogen in mineralization. Exotic grasses were more abundant in soils with higher rates of N mineralization and a less rocky texture. Consequently, sandy soils were likely to have higher exotic grass cover. Because of lower rates of N mineralization, rocky soils are less susceptible to exotic grass invasion, and control of exotic grasses are mostly needed in nonrocky soils.

ESTABLISHMENT OF PITCH CANKER IN THE SIERRA NEVADA

T. R. GORDON, PLANT PATHOLOGY, UC DAVIS

YEAR 3 OF 3

Research indicates that sugar pine trees are moderately susceptible to pitch canker and are at some risk of damage from this disease. Douglas-fir trees are much less susceptible, but the pathogen can survive on them for a year without inducing symptoms which may allow the pathogen to move to more susceptible host species. This underscores the importance of limiting the movement of Douglas-fir and other cryptic hosts from infested to uninfested areas. So far, pitch canker has not developed an association with pine-feeding insects in the Sierra Nevada mountains, and it may not become firmly established there.

INVESTIGATING CAUSES OF A FUNGAL DISEASE IN AMPHIBIANS

C. J. BRIGGS, INTEGRATIVE BIOLOGY, UC BERKELEY

YEAR 2 OF 2

Study results show that the impact of a new fungal pathogen, *Batrachochytrium dendrobatidis*, varies greatly among amphibian species. Species such as the mountain yellow-legged frog die within weeks or months of infection, while others, like bullfrogs, appear to become infected but do not succumb to disease. Results suggest that differences in stress levels or immune responses do not play a role in inter- and intra-species differences in the impact of this pathogen on its amphibian hosts. Therefore, management strategies involving immunizing frogs or increasing their immune status are unlikely to be effective against exotic fungal diseases infecting rare native California frogs.

PHYSIOLOGICAL BASIS FOR INVASIVENESS OF SAHARA MUSTARD IN SOUTHWESTERN DESERTS

J. S. HOLT, BOTANY AND PLANT SCIENCES, UC RIVERSIDE

YEAR 3 OF 3

The study shows how much Sahara mustard it takes to cause economic damage to crops, which habitats are most preferred by this weed, and its potential to spread into new areas. Sahara mustard appears to exhibit an "escape" strategy that allows it to thrive in the Mojave Desert environment. In experiments, Sahara mustard grows rapidly under a wide range of environmental conditions. Early, rapid, plentiful growth may allow Sahara mustard to take over resources and gain an early competitive edge over native annuals that have more precise germination requirements.

RISK ASSESSMENT AND EXPANSION DYNAMICS OF WILD PIGS IN OAK WOODLAND ECOSYSTEMS

R. A. SWEITZER AND R. E. LOGGINS, BIOLOGY, UNIVERSITY OF NORTH DAKOTA

YEAR 3 OF 3

Scientists estimate that 417 species or subspecies of native vertebrates and 408 native vascular plants with limited ranges are currently exposed to high densities of non-native wild pigs. Among the hundreds of native plants and animals exposed to non-native wild pigs, 97 different populations of vertebrates and plants are identified as threatened, endangered, or rare in California.



Adult female wild pigs with piglets at Henry Coe State Park in Santa Clara County in 2002. Photo by Rick Sweitzer.

A PROTOCOL FOR SCREENING POTENTIALLY INVASIVE WOODY SPECIES

M. REJMANEK, E. GROTKOPP KUO, AND J. OGDEN, EVOLUTION AND ECOLOGY, UC DAVIS

YEAR 2 OF 3

The study evaluates the ability to predict potential invasiveness of woody exotic species from relative growth rates of seedlings. Results indicate that invasive species grow more readily and have a higher seedling relative growth rate than less-invasive species. Scientists will compare invasive and less-invasive species under increasing drought conditions and two levels of nitrogen concentration to identify which species will potentially become more invasive as California's climate changes.

CONTROLLING EXOTIC GRASSES IN NATURAL COASTAL GRASSLANDS

C. LUKE AND P. ALPERT, BODEGA MARINE LABORATORY, UC DAVIS

YEAR 1 OF 3

This research will test promising, practical methods to control the spread of exotic grasses and promote the restoration of native plant species in coastal grasslands of northern California. Researchers are testing economical, nontoxic techniques that can be applied on a large scale.

IMPACT OF BARB GOATGRASS ON SOIL NUTRIENTS AND SOIL ORGANISMS IN GRASSLANDS

W. R. HORWATH, LAND, AIR AND WATER RESOURCES, UC DAVIS

YEAR 2 OF 2

Barb goatgrass has a formidable colonizing ability. A study showed that goatgrass negatively impacts biomass and seed production in its competitors. In the presence of competitors, including its own species, goatgrass actually produces more seed. This effect may contribute to the ability of goatgrass to rapidly displace its competitors and form dense monocultures. Soils that have been planted with repeated generations of goatgrass become progressively less fertile to annual grasses.

RELATIONSHIPS AMONG THE SUDDEN OAK DEATH PATHOGEN, NATIVE BEETLES, AND DECAY FUNGI IN OAKS

D. L. WOOD, INSECT BIOLOGY, UC BERKELEY

YEAR 3 OF 3

The study has identified fungal species commonly associated with disease and decay of hardwood species. This information helps to fully characterize fungal communities associated with sudden oak death. The greatest species diversity was found in infected trees after beetles had colonized the sapwood. It appears that preferential colonization of infected trees by bark and ambrosia beetle species introduce a variety of fungi, some of which cause disease to the host and accelerate the mortality of trees infected with the sudden oak death pathogen.

EVALUATING HOW FIVE BEETLE SPECIES SPREAD PITCH CANKER

D. L. WOOD, INSECT BIOLOGY, UC BERKELEY

T. R. GORDON, PLANT PATHOLOGY, UC DAVIS

YEAR 2 OF 3

Monterey pine is one of the most widely affected hosts of pitch canker. Researchers collected and examined wood-boring beetles from Monterey pine trees to determine how much of the pathogen the beetles carry and if they can transmit pitch canker to other pine species. The highest spore loads were obtained from just two of the five beetle species. Results will help to prioritize efforts to control specific beetle species based upon their spore load and their ability to transmit the pathogen to new hosts.

USING MOLECULAR MARKERS TO DESCRIBE THE SPREAD OF WATER PRIMROSE IN FRESHWATER WETLANDS

M. A. JASINIUK, PLANT SCIENCES, UC DAVIS

YEAR 2 OF 2

DNA studies indicate that invasive water primrose, a noxious aquatic weed, is not a hybrid but a unique, distinct species introduction, possibly of *Ludwigia grandiflora*. Identifying water primrose species and how it is introduced will facilitate regulation of cultivated germplasm that may be contributing to invasive populations. Identifying the origin(s) of the invasive populations can help to assess the relative role of sexual reproduction versus asexual reproduction in the spatial spread of this weed.

EFFECTS OF A RUST FUNGUS ON YELLOW STARHISTLE

J. M. DITOMASO, PLANT SCIENCES, UC DAVIS
A. J. FISHER, USDA-ARS, DAVIS
D. M. WOOD, CALIFORNIA DEPT. OF FOOD AND AGRICULTURE

YEAR 2 OF 3

Analyses suggest that a host-specific rust fungus may not have an effect on the overall biomass or seedhead production of yellow starthistle under normal growing conditions. However, findings suggest that rust fungus may decrease yellow starthistle's ability to compete with wild oat by about 60 percent. Further, increased proportions of wild oat in field plots seem to have a negative impact on yellow starthistle, regardless of rust infection.

DEVELOPING AN ARTIFICIAL DIET TO REAR BIOLOGICAL CONTROL AGENTS OF YELLOW STARHISTLE AND OTHER ALIEN WEEDS

L. SMITH, USDA-ARS, WESTERN REGIONAL RESEARCH CENTER, ALBANY

YEAR 1 OF 1

An artificial diet that was previously developed to rear the purple loosestrife root weevil can be effective for completing the development of larvae that are dissected out of plants. The ability of an artificial diet and "transfer kit" procedure to rear adults from larvae that are found feeding inside plants targeted for biological control is a major breakthrough for foreign exploration of biological control agents of weeds. It allows explorers to obtain taxonomic identification of insects that otherwise would be impossible to identify as larvae, and to provide live specimens for further research on which plants the weed prefers.

DISCRIMINATION OF HOST PLANT POPULATIONS OF A LEAF BEETLE FOR BIOLOGICAL CONTROL OF YELLOW STARHISTLE

L. SMITH, USDA-ARS, WESTERN REGIONAL RESEARCH CENTER, ALBANY

YEAR 1 OF 2

The discovery of three distinct populations of one insect species that are specific to three different host plants is an important breakthrough in classical biological control research. It means that there are probably many more potential host-specific biological control agents of weeds existing in nature than was previously thought. The molecular genetic tools used to identify these populations will allow scientists to discover similar cryptic species that can be developed as biological control agents for other weeds that have been difficult to control.

IMPACTS OF INTRODUCED PREDATORS ON RESTORATION OF NATIVE OLYMPIA OYSTERS

E. D. GROSHOLZ, ENVIRONMENTAL SCIENCE AND POLICY, UC DAVIS

YEAR 1 OF 2

This work will determine how invasive oyster drills affect native oyster populations. Information about the influence of exotic oyster drills along the salinity gradient may predict patterns of oyster drill predation in estuaries. Results will be used by reserve managers and shellfish growers to make informed choices about sites for restoration and to develop strategies to minimize potential losses of restored oysters.

AN EARLY WARNING SYSTEM FOR THE PLANKTONIC DISPERSAL OF NON-NATIVE AND INVASIVE MARINE SPECIES WITH DNA-BASED METHODS OF DETECTION

S. G. MORGAN AND J. NEIGEL, BODEGA MARINE LABORATORY, UC DAVIS

YEAR 1 OF 2

This study focuses on invasive marine species in the San Francisco Bay that threaten to spread along the California coast. Scientists are concerned about species that are carried long distances in the ballast tanks of ships and along the coast by tides and currents. Early detection of exotic larvae can prevent the establishment of invasive species in new areas and guide development plans to better manage ballast water discharge.

RISK ASSESSMENT AND MODELING TO SUPPORT EXCLUSION AND EARLY DETECTION OF INVASIVE PLANTS

J. M. DITOMASO, PLANT SCIENCES, UC DAVIS

YEAR 1 OF 2

A statewide survey of local experts will help determine the distribution in California of a set of exotic plants that have been identified as having high invasion potential. Climate-modeling software is being used to predict areas in California where these plants are likely to spread. Knowing where the plants are currently found and where they are predicted to spread will allow land managers to plan for early detection activities in their area and start eradication when populations are small.

IMPACTS OF SAHARA MUSTARD ON SOUTHWESTERN DESERT HABITATS: DEVELOPING EFFECTIVE CONTROL STRATEGIES

E. B. ALLEN, CENTER FOR CONSERVATION BIOLOGY, UC RIVERSIDE

YEAR 1 OF 3

Results to date indicate a substantial impact of the mustard on native annual plants, retarding their ability to flower and set seed. Impacts to animals have been more benign; the Coachella fringe-toed lizard responded negatively to the presence of the mustard. Control strategies, besides hand-pulling which is very labor intensive, researchers looked at supplemental watering to force mustard germination during summer. At sites where that is feasible, the mustard germinates but dies before flowering and setting seed. Natives that do germinate with this treatment appear more drought tolerant and can complete their life cycle.



Native annual desert pincushion, *Chaenactis stevioides*, surrounded by Sahara mustard seedlings. Photo by Robin Marushia.

PREDICTING THE SUCCESS OF FUNGAL PATHOGEN PUCGINIA JACEAE VAR. SOLSTITIALIS IN DIVERSE HABITATS AND IDENTIFYING FACTORS THAT AFFECT PATHOGEN SURVIVAL

L. SMITH, USDA-ARS, WESTERN REGIONAL RESEARCH CENTER, ALBANY

T. R. GORDON, PLANT PATHOLOGY, UC DAVIS

YEAR 1 OF 2

The introduced rust fungus, *Puccinia jaceae* var. *solstitialis*, has been released for classical biological control of yellow starthistle at more than 80 sites in 40 California counties. At many of these sites, initial inoculations led to infection, but at some, the rust did not reappear after a dormant season. Researchers determined that infective asexual spores have a short lifespan in the field, and survival in summer and fall was slightly longer in a cool, humid coastal climate when compared to survival in the hotter, drier Central Valley.

IMPACT OF MEDITERRANEAN ANNUAL GRASSES ON DETRITAL FOOD WEBS

D. BOLGER, ENVIRONMENTAL STUDIES, DARTMOUTH COLLEGE

YEAR 1 OF 2

Researchers are studying the impacts of litter from non-native annual Mediterranean grasses on semi-arid systems such as coastal sage scrub. Findings have shown positive, neutral, and negative relationships between non-native litter and the coastal sage system, especially its soil communities and dominant native shrub *Artemisia californica*. Experiments show litter greatly enhances the success of invasive grasses, and its removal can hinder invasion. The results of litter manipulation studies may be valuable in curbing the spread and impact of invasive Mediterranean annual grasses.



Eurasian watermilfoil. Photo by Jack Kelly Clark.

ECOLOGY AND MANAGEMENT OF EURASIAN WATERMILFOIL

J. M. DITOMASO AND D. F. SPENCER, PLANT SCIENCES, UC DAVIS

YEAR 3 OF 3

Sediment properties and sediment accumulation in particular river reaches do not appear to affect the invasion process of Eurasian watermilfoil. Monitoring the carbohydrate balance of Eurasian watermilfoil to enhance the efficacy

of harvesting as a control measure may not be practical or effective.

ECOLOGICAL BASIS FOR BIOLOGICAL CONTROL OF GIANT REED

T. DUDLEY, MARINE SCIENCE INSTITUTE, UC SANTA BARBARA

YEAR 1 OF 1

Researchers discovered several insect herbivores feeding on *Arundo donax* in California. The most important of these, *Talpa romana*, a small wasp, is being evaluated for its impact in California, and its distribution is being determined. The wasp can have locally high populations and can kill new, thin shoots and side shoots of giant reed. The wasp readily infests previously uninfested stands in common garden plots and may be amenable to redistribution to other sites in the state without wasps.

Urban

BIOLOGICAL CONTROL OF ASIAN HACKBERRY WOOLLY APHID

A. B. LAWSON, PLANT SCIENCES,
CALIFORNIA STATE UNIVERSITY, FRESNO
YEAR 1 OF 2

Scientists are monitoring three locations in the Central Valley for Asian hackberry woolly aphids. Researchers are collecting the aphid's natural enemies in Asia and will test them in quarantine to see if they can be used to biologically control the aphid.

USING PHEROMONES TO DETECT EXOTIC CERAMBYCID BEETLES

J. G. MILLAR, ENTOMOLOGY, UC RIVERSIDE
YEAR 3 OF 3

Scientists have demonstrated that cheap, generic blends of pheromones can be used to attract many species of pest cerambycids. Traps baited with these lures catch live specimens that can be used to identify the complete pheromone blend of each species. Researchers developed an outline of the types of chemicals that are used as pheromones by various cerambycid subfamilies, tribes, and genera. This will help to predict the chemical structure that a new exotic species is most likely to use, which will simplify identification of its pheromone blend and speed deployment of pheromone lures for monitoring.



Red-headed ash borer. Photo by Emerson Lacey.

BIOLOGY, MONITORING, AND TREATMENT OF ASIAN HACKBERRY WOOLLY APHID

A. B. LAWSON, PLANT SCIENCE,
CALIFORNIA STATE UNIVERSITY, FRESNO
P. M. GEISEL, UCCE, FRESNO CO.
YEAR 3 OF 2*

Results provide agencies, landscape professionals, and homeowners with valuable information regarding the lifecycle, monitoring, and control of the Asian hackberry woolly aphid. Examining the minimum effective rate for systemic applications of imidacloprid shows that rates as low as 1/8 of the recommended label rate provide effective season-long control of the aphid. This allows users to reduce the cost of application by decreasing the amount of material required. Researchers also documented natural enemies, forming a base to move forward with a classical biological control program against this pest.

MEDITERRANEAN PINE ENGRAVER AND REDHAIRD BARK BEETLE IN URBAN PINES

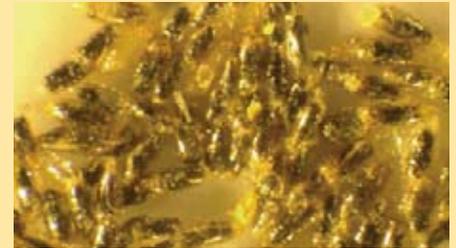
M. L. FLINT, ENTOMOLOGY, UC DAVIS
S. J. SEYBOLD, USDA-FOREST SERVICE,
PACIFIC SOUTHWEST RESEARCH STATION
YEAR 2 OF 3

The study shows that the Mediterranean pine engraver reproduces in various native and exotic pines and other conifers, suggesting that native forests and urban areas are vulnerable to the pest. Researchers have developed semiochemical baits to detect and trap the Mediterranean pine engraver and redhaired bark beetle. Mediterranean pine engravers in California were frequently found carrying spores that cause blue-stain fungus. Scientists also discovered a new character on the abdominal tip of the redhaired bark beetle that can be used to identify males from females. Studies show the flight of the bark beetle occurs year round with major peaks in May and July and is low from August to late January.

ESTABLISHING AN EGG PARASITOID TO CONTROL EUCALYPTUS LONGHORNED BORER

J. G. MILLAR, ENTOMOLOGY, UC RIVERSIDE
YEAR 1 OF 2

A new strain of parasitic wasp readily parasitizes eggs of the invasive, eucalyptus tree-killing beetle pest, *Phoracantha recurva*. Scientists have collected samples from Australia and identified them. Populations of this egg parasitoid have been established in the UC Riverside insectary and quarantine facility. The wasp colony is now in its second generation of successful rearing in California and will soon be released at southern California sites to control *P. recurva*.



Parasitized *P. recurva* eggs. Photo by Darcy Reed.

IMPLEMENTING A STATEWIDE BIOLOGICAL CONTROL PROGRAM FOR THE SPOTTED GUM PSYLLID IN EUCALYPTUS

T. D. PAINE, ENTOMOLOGY, UC RIVERSIDE
K. M. DAANE, INSECT BIOLOGY, UC BERKELEY
YEAR 2 OF 3

Researchers tested monitoring methods for the spotted gum psyllid and its natural enemies using a trap for adult psyllids and foliage sampling for immature stages of the pest. They found that psyllid populations in study areas generally had peak populations during May and June, but populations declined in the summer, before a second population peak between September and December. Populations tended to be higher in inland locations. A collection trip to Australia to collect *Psyllaphagous parvus*, a parasitoid attacking spotted gum psyllid, was successful, but the release permit process has been delayed.

Workshops sponsored by the UC Exotic/Invasive Pests and Diseases Research Program

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