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Rice Briefs

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In This Issue

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Early Pests of Rice

Tadpole Shrimp

Tadpole shrimp is becoming more problematic in California rice. In some areas, tadpole shrimp is the main pest attacking rice during the seedling stage. Many growers know they will have tadpole shrimp injury in some fields and schedule a management action soon after planting. It is important to remember that tadpole shrimp does not pose a threat to rice seedlings once they emerge through the water. At this time, seedlings are large and won't be affected by the feeding or foraging activities of tadpole shrimp. Understanding how tadpole shrimp grows is important to better direct monitoring and managing efforts.

Very likely, tadpole shrimp was already present when the first rice plantings were made in California at the beginning of the 20th century. However, its role as a pest of rice was not noticed until 1947. Until recently, tadpole shrimp was considered a problem only in California rice. In 2008, tadpole shrimp were found causing significant problems in water seeded rice in Missouri.

Tadpole shrimp are native of ephemeral fresh water habitats such as ponds and swamps. Their biology is very well adapted to these habitats, and therefore, very suited for successful habitation of rice fields. Below is a review of their biology and aspects of the rice field environment that favor their development.

Tadpole shrimp are observed in rice 8 -12 days after fields are flooded. Dried eggs laid during previous years hatch after being submerged in water for about 3 days. From the egg, a small larva emerges. This larva is called a metanauplius and is very difficult to see in the water – it's only 0.02 inches long. The young larva molts several times while growing, and continues to grow and molt even after it reaches the adult stage. Adults have two brood pouches in the posterior end of the body where they store eggs, and a single tadpole shrimp can produce several hundred eggs. Egg laying starts 11-18

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Tadpole Shrimp

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days after hatching (14-21 days after flooding), and usually starts when the tadpole shrimp is about half an inch in length. Some of the eggs produced by the adult can hatch in 5 days, so there can be more than one generation in a rice field during a season. Adults live for about a month, and are hermaphroditic, that is, an individual has both male and female reproductive organs at the same time. Cannibalism has been observed in the laboratory, where adult tadpole shrimp will feed on other tadpole shrimp's eggs, small tadpole shrimp larvae and dead individuals.

Tadpole shrimp eggs undergo "installment hatching". Some eggs may hatch a few days after being laid, others might survive through the winter and hatch the following year, and others might even hatch several years later. This variability in hatching times ensures that some of the tadpole shrimp will find appropriate conditions for development. It is a great survival mechanism and a great way to establish themselves in a rice field.

Some studies suggest that egg hatching is stimulated when the soil goes through a period of very low moisture content before flooding, and conversely, that egg hatching is inhibited when the soil is moist before flooding. This means that drying the soil before tillage encourages tadpole shrimp egg hatching. However, the benefits of a well prepared seedbed are much greater than any benefits derived from reduced tadpole shrimp egg hatching by not letting the ground dry properly before tillage.

Egg hatching is greatly influenced by water temperature. When water temperature is below 60 and above 84 ^{o}F, hatching is greatly inhibited. Water temperatures between 63 and 70 ^{o}F produce the greatest hatching. Even though many fields are flooded during the winter, water temperature is too low to stimulate hatching. During spring, areas with warmer air temperature soon after flooding will also have warmer water temperatures, creating proper conditions for tadpole shrimp egg hatch. Fields that receive cold water probably don't see much tadpole shrimp until the water warms up. During years with a cold spring we may see less tadpole shrimp early in the season than during a regular year. During a warm spring, the frequency of scouting for tadpole shrimp needs to be increased.

Water pH also affects the rate of hatching. Unfortunately, rice water pH soon after flooding is close to what the optimum for tadpole shrimp egg hatch is. Water depth does not affect egg hatch. However, the soil depth at which eggs are buried can influence hatch. Eggs won't hatch if they are buried at more than 0.5 inches. Most of the eggs that are on the surface of the soil when the field is flooded will hatch, and only 15% of eggs buried up to 0.5 inch will hatch. You can think of the amount of viable tadpole shrimp eggs in the soil as the "egg bank". Each year, tadpole shrimp lay more eggs and augment the egg bank. Tillage may help burring newly laid eggs, but at the same time it can bring older viable eggs to the surface.

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Tadpole Shrimp

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After hatching, the young larvae feed first on organic matter and small organisms present in the soil and water. As tadpole shrimp mature and rice becomes available, they start feeding on germinating rice seeds and young seedlings, and may dislodge seedlings because of their foraging activities.

Studies have shown that tadpole shrimp can also feed on weed seeds, small weed seedlings and mosquito larvae. In fact, in some areas of southern California, tadpole shrimp are used as biological control agents of mosquitoes in ponds and flood-irrigated fields. The same characteristics that make tadpole shrimp a pest in rice systems -installment hatching, rapid hatching after flood, fast growth, early maturation and high reproduction capacity- make them very attractive as biological control agents of mosquito larvae. In Japan, because rice plants are transplanted when they are no longer susceptible to tadpole shrimp injury, tadpole shrimp are considered biological control agents of small weeds.

Copper sulfate was one of the first pesticides used to control tadpole shrimp in rice. During the 1950's there were some failures in control and resistance was suspected. During the early 1960's, tests with copper sulfate found that the problem was the type of copper formulation used. Currently, the insecticide carbaryl and copper sulfate pentahydrate are registered for tadpole shrimp control in California rice. Carbaryl use is very limited; in recent years the percentage of annual treated acres has dropped to less than 1% of total planted acres. Copper sulfate is also used as an algaecide and its use has been decreasing in the past few years. In 2000, 246,000 rice acres were treated with copper sulfate. In 2009, 98,000 acres were treated. The reasons for this reduction in use are increases in copper sulfate price, inconsistency of supply, and variability in efficacy. Research has shown that rice straw residue can bind up to 75% of the copper applied. Even though experiments evaluating the effect of straw on copper and tadpole shrimp have not been conducted, it is suspected that straw-bound copper is less active against tadpole shrimp. Fields with lots of straw residue should be monitored closely even after copper applications have been made.

For more information and management recommendations, visit the website *UC IPM Management Guidelines: Rice* at **www.ipm.ucdavis.edu.**

Rice Seed Midge

Midges are small flies that look very much like mosquitoes. I call them flies because they belong to the insect order Diptera, the same order that includes flies, mosquitoes and gnats. Insects in the order Diptera are characterized by possessing only two wings, as you can infer by the name (di, referring to two; and ptera, meaning wings). Other insects, such as plant bugs, beetles and bees, have 4 wings.

There are many midge species that can live in rice fields. In a 1962 survey of rice fields in the southern area of the Sacramento valley, 30 different species were found. However, not all of these species are injurious to rice. Some midge species are predators and feed on other midges, others are found feeding on decaying organic matter and algae. Three species have been associated with rice injury most frequently: *Crycotopus sylvestris*, *Paralauterborniella subcincta* and *Paratanytarsus sp*. Identification of midges to species is difficult, therefore, the best way to determine the presence of injurious species in the field is to inspect seeds and seedlings for injury and to look for midge cases on the bottom of the flooded field.

Midge eggs are laid by the female on the surface of the water. After a couple of days, eggs hatch and small larvae emerge. The larvae live on the soil surface, where they build small silken tubes or cases that incorporate pieces of organic matter and soil. They use these cases as refuge, staying inside of them most of the time. Initially, midge larvae feed by filtering water and swallowing small microorganisms and organic particles. As they grow, they are capable of feeding on vegetation, such as germinating rice seeds and seedlings. Studies have shown that the number of midge larvae in rice fields can vary drastically depending on species, time of flood and weather. However, it is not uncommon to find between 100 and 400 larvae per square foot. After 4 larval instars, midges pupate inside their tubes. When the pupa completes its development, it swims to the surface of the water and the adult emerges. Adults then fly in search of a mate, swarming on the surface of

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Winter Meetings and Rice Production Workshop Presentations Available On-line

If you missed the 2011 Rice Growers Winter Meetings or Rice Production Workshop, the presentations are now available at the UCCE Colusa County Rice website. The presentations are available in PDF format that can be printed. If you have questions about the content, please contact me at 530.458.0578 or laespino@ucdavis.edu.

The presentations are available at: http://cecolusa.ucdavis.edu/rice/

Rice Seed Midge

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the water. Adult midges generally do not feed, but sometimes they can take flower nectar and aphid honeydew. These carbohydrate-rich foods allow them to live longer and produce more eggs.

Midge damage to rice is sporadic and difficult to predict. Stand establishment failures due to midge attack may occur some years but not in others. Midge larvae can hollow out rice seeds and feed on the emerging coleoptile (primordial shoot) and coleorhizae (primordial root), killing germinating seeds. Once seedlings are developed, midges may injure rice plants by chewing holes in leaves; however, this type of injury does not affect stand establishment. The best way to prevent midge problems is to seed fields as soon as possible after flooding, and to monitor fields closely until seedlings are several inches long.

After flooding a field, the number of diatoms, phytoplankton and plant material under water increases rapidly. Early midge larval instars can use diatoms and phytoplankton as food sources and the presence of submerged weeds provides good habitat for midges. Seeding quickly after flooding will allow rice plants to reach a size that is not susceptible to midge and avoid damage.

If midge injury is observed, the most effective management strategy is to drain the field. This will kill some midge larvae and promote rapid anchoring of rice plants.

For monitoring guidelines and more information, visit the website *UC IPM Management Guidelines: Rice* at **www.ipm.ucdavis.edu.**

New University of California Rice Blog

Three Farm Advisors from the University of California Cooperative Extension will be publishing a blog dealing with rice production starting this growing season. The UC Rice Blog will serve as an Internet-based journal that will feature pictures and comments on issues the Advisors encounter in the field that are of interest for those involved in rice production.

The Farm Advisors are Luis Espino, Colusa, Glenn and Yolo counties; Chris Greer, Sutter/ Yuba, Sacramento, and Placer-Nevada counties; and Cass Mutters, Butte County.

To find the blog, go to: http://ucanr.org/blogs/riceblog/

Meeting announcements and newsletters are also available at our website: http://cecolusa.ucdavis.edu

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