RICE PLANT INJURY
by Invertebrate Pests

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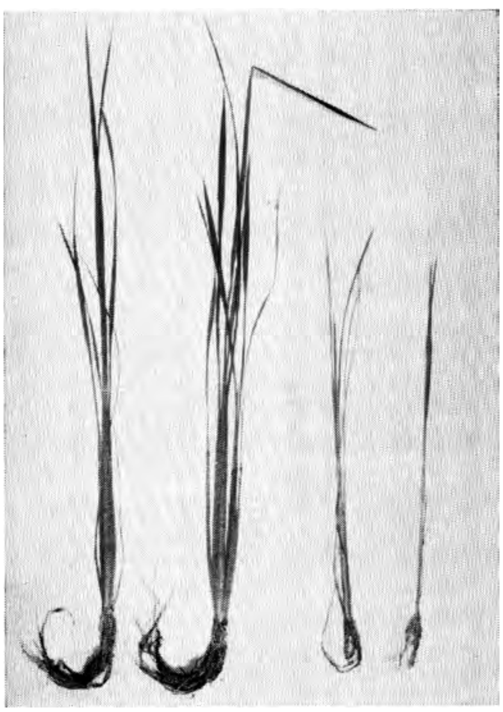
PEST DAMAGE to rice plants in California most frequently occurs during the first two months of the growing season. This injury is generally caused by the tadpole shrimp, the rice leaf miner, and the rice water weevil. The first two pests are found throughout the rice-growing areas of the State. They may be responsible for a reduction in plant stand from April to June but their activity is greatly reduced or of little consequence by early July. The rice water weevil, presently limited to the northern rice growing counties, will feed on the rice plants during the entire growing season. This weevil very seldom causes a loss of plant stand, but the feeding of the young on the roots may stunt the plant and reduce the yield if the larvae are abundant.



Rice plants caged with weevils, right. Plants of the same age but caged and free of weevils, left.

Tadpole shrimp

This crustacean, *Triops longicaudatus* (Le Conte), was given the name tadpole shrimp because of its similarity to the true tadpole in color, size, and swimming activity. The shrimp hatch from minute reddish-orange eggs and pass through a series of stages until maturity, at which time they may be 2 inches long. They are first seen in rice fields one to two weeks following flooding.

Tadpole shrimp in their early stages of growth are frequently confused with a small bivalve crustacean sometimes called a "clam shrimp" or "rice field clam." These "clam shrimp" are about twice the size of a rice seed and are frequently present in large numbers but *do not damage the rice.*

Young tadpole shrimp feed on the organic content of the mud and small organisms. As they grow larger, their food and foraging habits change and a high population may be a serious problem to the rice grower. Small, submerged rice seedlings are delicately rooted and often coated with minute gas bubbles. The shrimp may easily dislodge these seedlings by burrowing in the mud, and by chewing the leaves and roots. The dislodged plants generally float to the surface and wind movement scatters them along the rice field levees. Windrows of rice seedlings along the shoreline can also be the result of an improperly prepared seedbed. If shrimp are responsible, the uprooted seedlings will frequently show some evidence of the tips of the leaves being chewed or broken off. A rice field with continuous muddy water is generally a reliable indicator although not positive proof of a shrimp infestation.

To determine the extent of damage to young rice, various shrimp populations were placed in 3-foot-square cages within a rice field. The test was conducted at the Rice Experiment Station, Biggs. The small shrimp were taken from a field flooded at the same time as the test field. Table 1 shows a maximum reduction of 25% of the stand when the shrimp population was 8 per square foot. However, there was no significant reduction in yield of grain recovered at this plant population and shrimp level. The loss of plant stand was apparently compensated by increased plant stooling and more heads of grain per plant.

TABLE 1—INJURY TO RICE BY THE TADPOLE SHRIMP

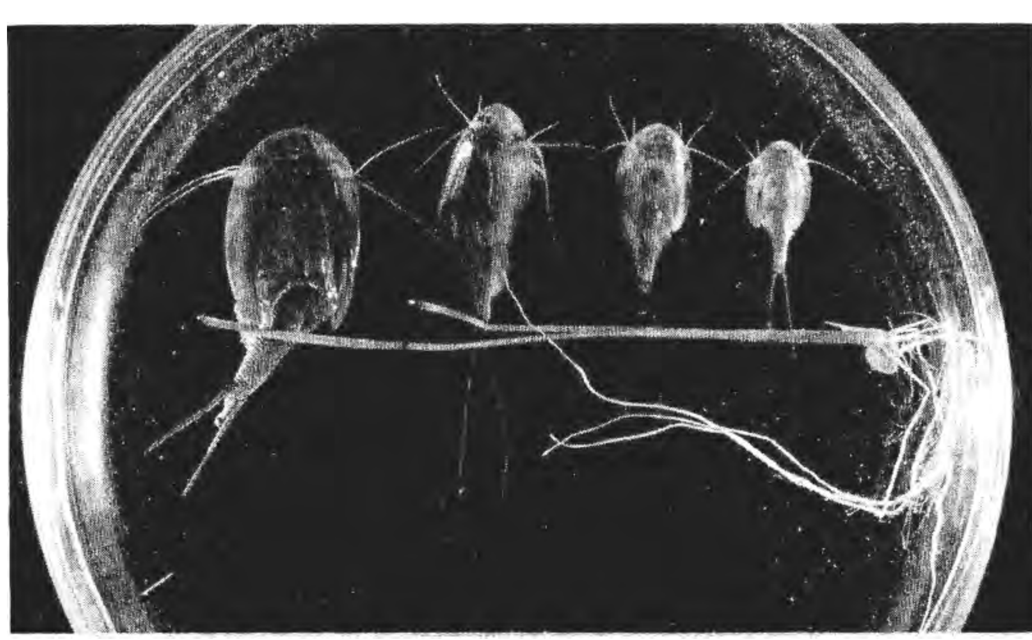
No. shrimp per sq. ft.	Average No. plants per sq. ft.*	Per cent loss in plants
0	12.7	..
2	11.6	8.6
4	10.6	16.3
8	9.6	25.5

* Average of six replications.

Rice leaf miner

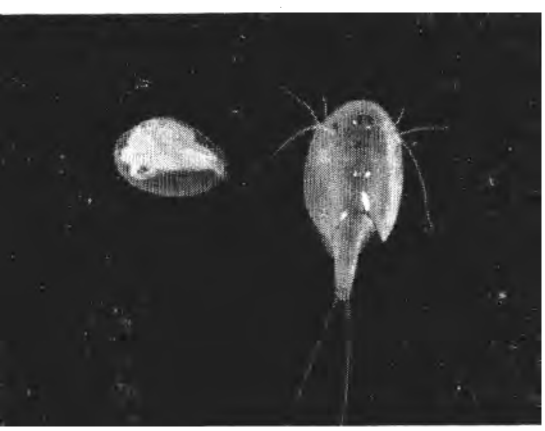
This small fly, *Hydrellia griseola* (Fallen), has been known to be present in California rice fields since 1922. The weather conditions occurring in 1953 favored its buildup and required extensive control measures. The adult females lay their small white eggs predominantly on rice plants that have emerged and are lying on the water surface. The eggs hatch in three to five days and the

Photo to right shows clam shrimp on left and young tadpole shrimp to right. Several stages of growth of the tadpole shrimp and an uprooted rice seedling with the leaf tip missing are shown below.



larvae mine the leaf tissue between the external layers for two to three weeks before they pupate. More than one larva may be mining a single leaf and the larvae may transfer from one leaf to another after they consume the tissue of the plant they were previously mining. The miner's presence on the leaf is indicated by a blotched, greenish-brown appearance. The larva can be located by passing the leaf between the thumb and forefinger until a swelling is felt.

The damage caused by the larvae is dependent on the number that mine a single plant and the length of time that mining is continued in the plant. Conditions that retard or prevent rice blades from attaining a vertical position and thus increase susceptibility to attack from the miner include: (1) low air or water temperatures and unfertile soil, resulting in weakened plants and slow growth; (2) heavy wind movement by direct force, wave action, or by forcing algal growth over floating rice blades; (3) permanent excessive deep water or mismanagement of water by increasing its height too fast after an initial drop; and (4) heavy algal growth will occasionally break loose from underwater substrata and form large floating blankets that will stick to floating rice blades and prevent their rising or



hinder new growth from breaking through.

These four factors are all detrimental to plant growth and favor continued activity of the rice leaf miner. The best measure of the seriousness of an attack on rice is the extent and intensity of activity on the newest plant growth. The first one or two rice blades that are above water may be mined without killing the plant if new growth is allowed to continue, although it undoubtedly weakens the plant and may delay maturity. If conditions are such that the new growth is continually mined, then the plant dies because of interruption of nutritional and respiratory functions. Two to three generations may occur on rice but the second and third generations are considerably smaller, limited to cooler sections of fields and are generally heavily parasitized.

Rice water weevil

This insect pest, *Lissorhoptrus oryzophilus* (Kuschel), was first brought to the attention of California rice growers in the August, 1959, issue of *California Agriculture.* At that time, it was limited to a 400 square mile area in Butte, Glenn, and Yuba counties but has spread to Colusa, Sutter, and Sacramento counties.

The adults emerge from hibernation in April and May and begin feeding on the leaves of newly emerged rice or they may feed on the numerous grasses associated with irrigation water. The feeding of the adult appears as a very characteristic rectangular slit on the upper surface and parallels the veins of the leaf. If this adult feeding is very extensive on young seedlings, it may kill them, but generally the weevil does not occur in sufficient numbers to reduce the plant stand. The weevils (only females have been found in this State) crawl down the plant stems below the water surface and oviposit.

The eggs are predominantly found in the leaf tissue above the crown or occasionally in the roots. The larvae emerge from the eggs in 10 to 12 days and spend this stage of their life cycle feeding on the plant roots. If these larvae, sometimes called root maggots, are numerous, the roots will be pruned, plants will become stunted, fewer tillers will be produced and consequently less grain. Pupation occurs on roots in oval cells lined with mud.

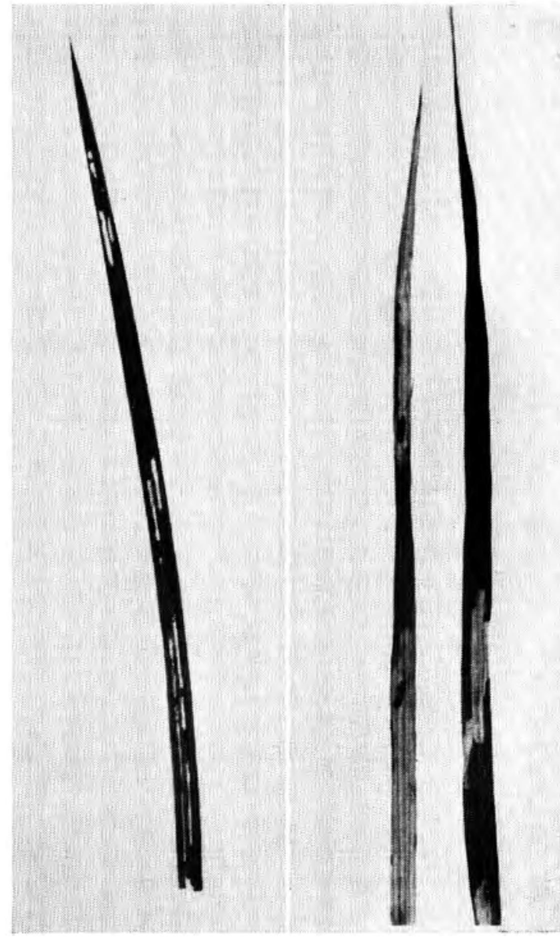
Biggs study

A study was conducted at the Rice Experiment Station, Biggs, using 3-foot-square cages and controlled populations of adult weevils, to determine the extent of damage to rice flooded continuously in 6 inches of water. The results given in table 2 show a maximum reduction in yield of grain of 32% when the ratio of weevils to plants was one to one. No sig-

TABLE 2—INJURY TO RICE BY THE RICE WATER WEEVIL

No. weevils per plant	Average plant height in. (7 wks.)*	Per cent reduction of grain
0	24.0	..
¼	20.6	7.3
½	19.8	15.5
1	18.3	31.6

* Average of six replications.



Feeding scars of the rice water weevil adult, left. Leaf mines and pupae of the rice leaf miner, right.

nificant reduction in plant stand occurred in this test.

Populations of weevils of this magnitude have not been observed to date in California rice fields, with the possible exception of the edges of some fields. The overwintering generation of weevils live until the latter part of June and are most frequently found feeding and ovipositing at the margins of the fields. The new generation of adults can be found on rice plants from July to October but exhibit a more uniform infestation throughout the field. Studies are currently underway to determine the effect of the second generation of weevils on the rice plants. No chemical controls are presently recommended for root maggots as the weevil populations are considered to be below the economic level. Studies in progress show a preplant soil treatment to be the most effective control method for rice cultural practices of continuous flooding.

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