BIOLOGICAL CONTROL of RUSSIAN THISTLE

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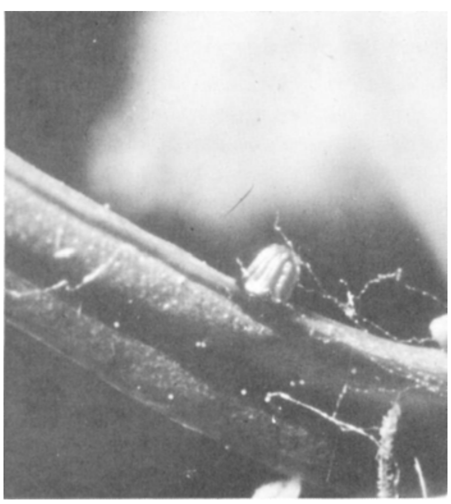
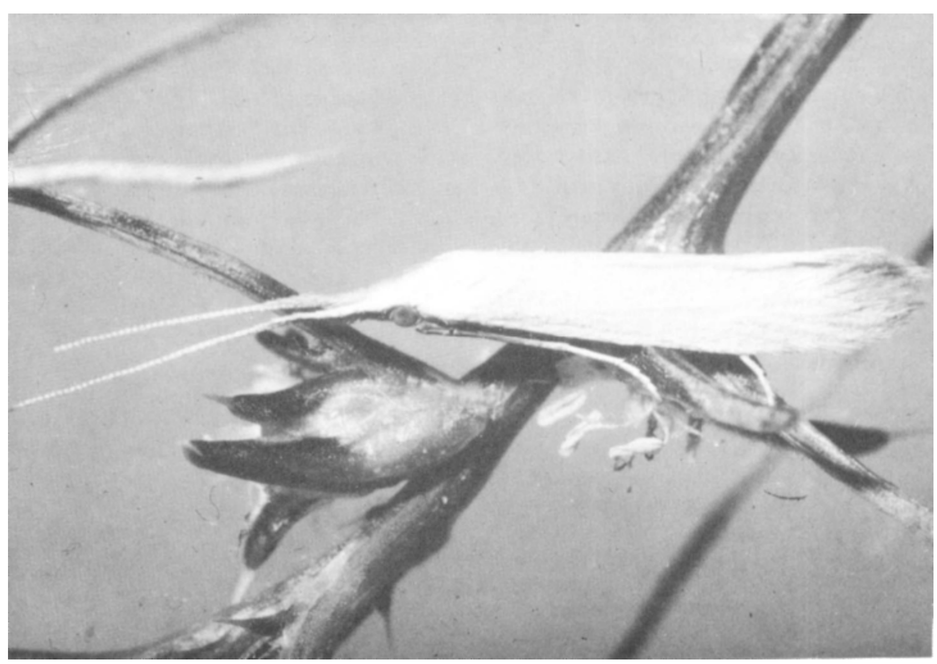
Russian thistle (*Salsola iberica* Sennen and Pau), a plant native to Eurasia, has become a widespread weed in California and other western states. In these areas it serves as a favored alternate host plant for the beet leafhopper, *Circulifer tenellus* (Baker), vector of the destructive "curly top" virus of such crops as sugar beets, tomatoes, and melons. The plant also harbors a variety of other insect pests such as lygus and stink bugs. These large, bushy "tumbleweeds" are common sights on neglected or abandoned croplands, vacant residential and industrial lands, and highway and railroad right of ways. The plants fracture at the base at maturity and scatter seeds as they are blown about by the wind. Tumbleweeds fill irrigation and drainage canals, pile up against fence and buildings, fill backyards and swimming pools, and startle motorists who encounter them while driving. Unsightly accumulations of the dead, dry plants are not only difficult to remove, but also create fire hazards and traps for other windblown debris.



Egg of **Coleophora parthenica.** (30×)

Larva of **Coleophora parthenica** in stem of Russian thistle. (10×)

Several species of insects attack Russian thistle in its native habitats, helping to keep it at low levels. Among them is the moth, *Coleophora parthenica* Meyrick (see photo), which is native to North Africa, the Middle East, and Asia. In the extensive host plant specificity tests conducted with *C. parthenica* by Egyptian entomologists, by entomologists at the Commonwealth Institute of Biological Control in Pakistan, and by entomologists at the USDA Biological Control of Weeds Laboratory at Albany, California, *C. parthenica* was found to be host-specific to herbaceous, annual species of *Salsola* and to the closely related plant, halogeton (*Halogeton glomeratus* [M. Bieb.] C.A. Mey.).



Adult **Coleophora parthenica.** (12×)

The latter plant is a widespread, toxic range weed in several of the western states.

Overwintering

Coleophora parthenica overwinters as mature larvae inside the stems of dead Russian thistle plants. The larvae pupate and the moths emerge in the spring. Mating occurs within 2–3 days. The small, straw-colored eggs are laid singly on the leaves near the tips of branches (see photo). The hatching larvae bore directly into the leaves and then into the branches and stems where they complete their development (see photo). The fully-grown larva cuts an exit hole in the stem, leaving only a thin layer or "window" of epidermis to cover the exit hole; it then retreats a short distance into its tunnel and pupates. At eclosion, the cream-colored moths force their way out of the stem through these windows. At least two generations are expected annually in the San Joaquin Valley. An additional generation may occur in parts of southern California. Mature larvae of the last annual generation overwinter inside the dead plant stems as noted.

Plants with moderate infestations of *C. parthenica* larvae observed in Egypt, Pakistan, and Turkey were somewhat stunted, had few branches, and had gnarled, thickened basal stems. Samples taken by Egyptian entomologists throughout the 1973 season showed an average of 44 larvae per 100 stems at two study sites. Released from its own natural enemies during its introduction to North America, *C. parthenica* should reach higher population densities in California, which hopefully will cause sufficient stress to severely stunt, if not kill, Russian thistle.

During the spring of 1973, field releases of moths reared from overwintering larvae collected in Pakistan were made near Bakersfield, Cuyama, Coalinga, and Tracy in the San Joaquin Valley and also in Nevada, Utah, and Idaho. Limited numbers of moths reared from larvae imported from Egypt were liberated at San Ysidro and Chino in southern California. The insects successfully completed two generations during 1973 at the Bakersfield, Coalinga, and Tracy sites, but establishment at Cuyama was not determined. The Egyptian material failed to establish at either southern California location.

In Idaho and Utah, the moths were liberated in the open. At the California and Nevada locations, the moths were released into large field cages containing immature Russian thistles. From 30 to 100 moths, about half of them females, were colonized at each site.

During the spring of 1974, larvae were found to have successfully overwintered at the Coalinga and Tracy sites in California. However, no *C. parthenica* were recovered at Bakersfield. Apparently one obstacle to the ready establishment of *C. parthenica* will be the scattering by the wind of the tumbleweeds that contain the overwintering larvae. The small, initial colonies thus become too widely dispersed to allow the newly emerged moths to readily find mates. This situation occurred at Bakersfield during the winter of 1973–74, when strong winds blew the infested plants away from the colonization site. Infested plants may have to be contained overwinter by enclosures at some locations until large field colonies have been established, but eventually the plant's tumbling habit will aid in spreading the moths.

Additional releases

Additional releases of *C. parthenica* moths from Pakistan were made by the first author and cooperators in the late spring and early summer of 1974 near Indio, Boron, Lone Pine, Bakersfield, Tracy, and Sacramento. Concurrent releases of Pakistani or Turkish moths were made at Chino, Colton, Moreno, Corona, Lakeview, and Rancho California by the second author and co-workers. An immediate goal of this project is to establish strong field colonies of *C. parthenica* at these and other selected locations in the state. Once this is accomplished (and if the insect continues to show promise as a biological weed control agent), it will be made available for general distribution to the many other areas where Russian thistle is a problem.

The California Department of Agriculture partially funded the early research and development phases of this program by the USDA; in 1974 the California Division of Highways (Caltrans) continued the partial funding. These two groups have also cooperated with the USDA in site selection and manpower needs.

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FOOD SYS

INVESTMENTS in the U.S. food and fiber system from production through final sales are so large that few of the individuals and firms comprising it can afford to leave their destiny to chance or individual whims. Large-scale retailers and food service firms require consistent supplies at predictably uniform prices, as do the food manufacturing firms that supply them. Moreover, individual farmers with large capital investments cannot gamble on future market outlets.

The food industry, which should be viewed as a system, consists of all stages in the production and supply of materials used in agriculture, the production of commodities on the farm, processing of commodities, and the distribution of finished products at retail stores and eating establishments. Because the system is so large and complex, improved coordination is badly needed. The use of contracts is essential for helping bring about this coordination.

Need for coordination

We have moved from a system of price-making at large terminal markets to prices based on decentralized or shipping point marketing. Large-scale buyers of livestock and fresh fruits and vegetables negotiate purchases directly at the shipping point and bypass the terminal market except for emergency shortages. Packers sell processed fruits and vegetables directly to large-volume purchasers, under somewhat loose terms of reservation bookings that later may become actual sales. Broiler prices are negotiated between large integrated operations and large-scale retailers or buyers. Grain prices are established in a complex mixture of organized exchange trading in spot and future markets. Thus different marketing practices have developed for different commodities.

As the agricultural and food industry has become industralized, it has developed some common characteristics of industry, including trends towards separation of capital, management, and labor; specialization of farming enterprises resulting in purchase of production inputs; increased applications of capital as substitutes for labor; and increased dependence on science and technology. There is