Snail against snail

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The decollate snail, *Rumina decollata* Linneaus (Family Achatinidae, Subfamily Subulininae) attacks, kills, and consumes brown garden snails, *Helix aspersa* Muller (Family Helicidae), especially those less than half grown. This suggests the possibility that the snail can be used as a biological control against the brown garden snail, the most important pest land mollusk in California. Since 1972 the decollate snail has been observed in the laboratory and in outdoor confinement cages, private gardens, citrus groves, and freeway plantings. It displays very little tendency to eat healthy leaves, flowers, or fruits still attached to the plant but may vigorously feed on old leaves, especially those in contact with the soil, and fallen bruised fruit.

The decollate snail evolved in North Africa and is commonly found around the Mediterranean Sea. It has been distributed widely in commerce; because it is a burrowing species, the eggs, hatchlings, and juveniles are not easily detected in the soil of plants being transported in containers. In the United States it was reported first from South Carolina in 1813 and has since been found in Alabama, Arizona, California, Florida, Georgia, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, Texas, and Virginia.

In California the decollate snail was discovered first in Riverside on January 12, 1966, and by April it had been reported by Agricultural Commissioners in four other counties. These well-established colonies implied introduction perhaps as much as 10 years earlier. They included a citrus grove with a residence at Ojai (this property has never had a brown garden snail population), and residential properties in Riverside, San Bernardino, Rialto, La Habra, and San Diego. Today on these properties brown garden snail is either absent or is present in low numbers, and mature individuals dominate the size class distribution. Properties nearby but without the decollate snail generally have high populations of brown garden snail requiring bait applications for control. Properties that have had decollate snail for 15 or more years probably give a realistic sense of results to be anticipated from establishing new colonies, at least in southern California.

As this study progressed, it became apparent that the decollate snail had been introduced in specific locations 5 to 10 years before its discovery as an established population. To date 13 counties are known to harbor the decollate snail. Studies in citrus groves are in progress in the counties of Imperial, Los Angeles, Orange, Riverside, San Diego, Tulare, and Ventura. Studies of freeway plantings are being conducted in Fresno, Orange, Sacramento, San Bernardino, San Diego, Santa Barbara, and Ventura counties. Observations are continuing at private residences in Kern, Orange, Riverside, San Bernardino, and San Diego counties. In March 1980 the decollate snail was found in San Jose, Santa Clara County.

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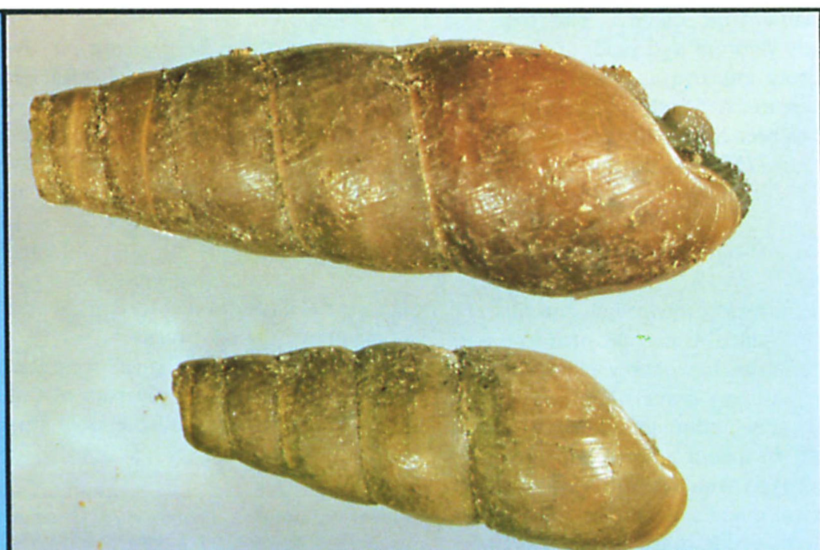
The decollate snail feeds on brown garden snail without harming healthy plants or fruit.

Neither the decollate snail nor brown garden snail prospers in natural (undisturbed) habitats in southern California. Both species appear to thrive in cultivated situations with frequent irrigation. The climbing habit of the brown garden snail is well known, but the decollate snail climbs up tree trunks and walls or fences only when heavy rains flood it out of its accustomed niche, which is in the upper inch of soil.

In home gardens feeding by the decollate snail has been reported on leaves of *Dichondra*, baby tears, and violets, on cotyledons of germinating seeds, on very young seedlings, and on flower petals. It is not clear if the decollate snail initiates this sort of feeding or if it follows mechanical bruising caused by pruning, mowing, human or animal traffic, or initial bites by primary plant feeders. It is difficult to differentiate feeding damage of decollate snail to green, living plants from that of other organisms that feed similarly on living plant tissue, such as brown garden snail, slugs, and pill bugs. After several true leaves have been formed, the decollate snail usually has little further interest in the plants.

On 14 species of common garden ornamentals and vegetables, an outdoor caged forced feeding test at University of California, Riverside, demonstrated that the decollate snail would feebly attack established growing plants. Carrots (roots) while still growing in the soil were only occasionally nipped on the aboveground exposed portion. Yet when those same carrots were pulled up and laid on the soil, the decollate snail fed on them extensively. Only very minor feeding on growing green leafy plants was observed in these tests, and in no instance was a well-established plant destroyed. However, new sprouts of recently sown seeds were attacked.



Max Badgley

In southern California, decollate snail, shown actual size, usually reaches maximum size of lower snail. Upper snail is laboratory-reared "giant."

Decollate snails have nested under fruit on ground without causing damage. This citrus grove has had a decollate snail colony for at least 15 years.

Typical damage by brown garden snail.

In San Bernardino along a well-irrigated north-facing freeway planting of *Baccharis, Osteospermum,* and later *Carpobrotus,* three years beginning in 1974 elapsed before the progeny of succeeding generations of an introduced colony of 1,900 decollate snails had worked their way approximately 600 feet eastward. There was no migration to the west because of a wide dry concrete apron beneath an overcrossing, or to the south into residential properties at the top of the approximately 45° slope because of an intervening path of bare soil 4 feet wide to which Caltrans personnel liberally applied ammonium sulfate as a deterrant to movement of snails. Further movement eastward was blocked by another wide dry concrete apron beneath an overcrossing. No massive migration onto the surface of the highway by the decollate snail occurred, whereas previous such behavior by brown garden snail had threatened to cause passing vehicles to skid.

A combination of factors brought the brown garden snail problem under control: replacement of some of the original ground cover, *Osteospermum,* with *Carpobrotus*; reduced irrigation; continued use of snail baits and repellents on the periphery; and predation mainly on juvenile brown garden snail by the decollate snail within the plant mass. Former practices that were discouraged were broadcasting of baits into the ground cover, which reinforced the resistance of brown garden snail to metaldehyde (*California Agriculture,* June 1975), and excessive irrigation. This was not planned as an integrated pest management program, but in retrospect, that is what it was. We hope the strategies and tactics that evolved during this study may serve as guides for future programs tailored to meet specific local conditions.

The rate of decollate snail spread in citrus groves varied widely from grove to grove; frequency, duration, and type of irrigation were the main determinants. In general, greater movement between rows occurs under sprinklers than with drip systems, but the greatest movement occurs during light, warm rain. Acceptable biological control of brown garden snail has not yet occurred in the five groves shown in the table, possibly because the decollate snail is continuing to spread, and its population is not yet of sufficient density to effect economic control of brown garden snail. However, brown garden snail counts are declining in pockets within the Baker grove (Orange County) test plots where the decollate snail occurs in relatively large numbers.

The high compatibility of decollate snail with citrus production is indicated by the following observations. The heaviest known population of decollate snail has been reported from Yuma, Arizona, by a pest management consultant who estimated 22.5 gallons of snails per acre in irrigation basins of Valencia oranges. (There are approximately 3,400 snails in the ¾- to 1-inch size range per gallon.) There was no snail damage to fruit, and brown garden snail was not present. Near Lindsay, California, in groves with large decollate snail populations, small numbers of the snail have frequently been seen beneath large green navel oranges resting on the soil in depressions caused by their weight, but no feeding scars were apparent.

When attempting to integrate decollate snails into a brown garden snail control program, there may not be enough available to inoculate all trees in a grove simultaneously, so an alternate method is to inoculate a cluster of core trees and monitor the spread. Results will be slow, as indicated in the table.

Because both methiocarb (Mesurol) and 7 percent metaldehyde kill the decollate snail, it is important to provide an unbaited buffer zone between the expanding colony and that portion of the grove receiving poison bait. The maximum dispersal rate measured for

Rate of Spread of Decollate Snail from Core Colonies until September 1979

Locality		Number of trees inoculated	Snails released	Date	Months elapsed	Number of trees with snails
Grove*	County					
El Toro	Orange					
Sprinkler		4	400	4/75	54	700
Drip		2	400	4/75	54	400
Fillmore	Ventura	4	700	4/75	54	525
Holtville	Imperial	3	1,000	9/75	48	416
La Verne	Los Angeles	2	700	10/75	47	36
Pauma Valley	San Diego	2	200	4/75	54	80

*All study groves sprinkler irrigated except for one drip plot in Orange County.

the decollate snail was 65 feet in three months in a sprinkler-irrigated grapefruit grove near Hemet, Riverside County. Assuming the effectiveness of baits will be dispelled within four weeks, a two-tree buffer would suffice to protect developing colonies of the decollate snail. As the snails disperse, the buffer zone should be advanced ahead of them.

We believe the most effective method of uniformly building up the decollate snail would be to broadcast, at first, 50 or more snails per tree over an entire grove. This release method presumes a ready supply of decollate snails and a relatively low initial population of brown garden snail, as would be expected after a baiting program. This method may also be used as a preventive measure before brown garden snail moves into a clean grove from neighboring infested properties. On their own initiative, certain major citrus-producing companies in southern California have begun to mass-produce decollate snail for release against brown garden snail on their properties.

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California red scale predator may create citricola control dilemma

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Sooty mold fungus on navel orange leaves is result of citricola scale infestation.

Approximately half of California's citrus is grown in the San Joaquin Valley along the western foothills of the Sierra Nevada. The climate is sufficiently uniform that the severity of pest species and effectiveness of natural enemies do not vary greatly from one part of the area to another. Although a large number of insect and mite species are occasionally injurious to citrus, only ten are potential economic pests, capable of either reducing the crop yield or lowering the market grade of the fruit if population densities are not suppressed either naturally or artificially.

Currently, chemical agents are required in citrus pest management to control all of the ten major pests except twospotted spider mite and some scale insects. For example, insecticides are needed to reduce numbers of citrus cutworm and fruittree leafroller larvae in some groves and to prevent injury by citrus thrips in most groves. Acaricides are applied to control citrus red mite, unless climatic conditions or a naturally occurring virus limits their numbers. Such sprays also control twospotted spider mite, which is becoming more widely distributed in the Central Valley each year.

Predators and parasites also help control some of the important citrus pests. Sixspotted thrips, *Scolothrips sexmaculatus* (Pergande), can be an effective predator of twospotted spider mite. The parasitic wasps *Metaphycus luteolus* (Timberlake) and *Comperiella bifasciata* Howard keep brown soft scale and yellow scale, respectively, below injurious levels, and the Vedalia lady beetle, *Rodolia cardinalis* (Mulsant), controls cottonycushion scale.

For these natural enemies to be effective, pesticide applications must either be avoided or be carefully timed in controlling target pests. However, beneficial fauna may have developed tolerances to pesticides, as has been indicated in the last few years by relatively few outbreaks of nontarget pests following applications of commonly used insecticides and acaricides.

The remaining two major pests, California red scale (CRS) and citricola scale, must be considered together. Currently, chemical applications for CRS also control citricola scale. If present attempts to develop biological or other nonchemical controls of CRS are successful, citricola scale may return to its pre-1950 status as a severe pest. Our purpose here is to present information to encourage citrus integrated-pest-management researchers to develop management techniques for these two pests concurrently.

History of two scale pests

Citricola scale has been an economically important pest of San Joaquin Valley citrus since the early 1900s, but CRS was not found on citrus until the mid-1950s. Following World War II, citricola scale was effectively controlled by many of the new organochemicals, and shortly thereafter, CRS became established in most Central Valley citrus properties. Early statewide attempts to contain and eradicate CRS, using new pesticides and oil, proved economically unfeasible once infestations became widespread. Eradication of spot infestations of CRS was often successful, but inspection schedules were inadequate and reinfestation occurred from undetected infestations. The regular use of parathion in these programs virtually eliminated citricola scale, because the required dosage for CRS control far exceeded that needed for citricola scale control.

Attempts to introduce, colonize, and permanently establish a number of natural enemies of CRS are continuing. Apparently, introduced parasites that are effective in southern California have not been established in Central Valley citrus orchards.