A PRELIMINARY REPORT ON THE SNAIL *DRYMAEUS DORMANI* IN CITRUS GROVES IN FLORIDA

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An arboreal snail, *Drymaeus dormani* Binney, has been reported in citrus groves in Florida for many years. Often, growers have believed that the presence of these snails in their groves has been of great benefit. No real effort has ever been made to either substantiate or repudiate these claims. In the spring of 1946, the author started a study of this snail in three groves in Lake County and in one grove in Sumter County. The following discussion reports these observations and is an attempt to explain, in a preliminary way, the possible role of this snail in citrus culture in Florida. Continued observations will be necessary before more definite conclusions can be drawn.

HISTORICAL

In 1857, W. G. Binney (*1*)[1] described a snail taken by O. J. Dorman near St. Augustine as a new species, *Bulimulus dormani,* and in 1878, he (*2*) made a more complete and accurate description. A complete bibliography on description and synonomy is listed by Pilsbry (*6*) in his monograph on land shells written in 1946 and Norris (*5*), in 1947, described the activties of this snail in one grove in Lake County.

Following Binney's description, the snail was reported (*3*) near the Matangas River, at Port Orange, at Oak Hill in Volusia County, and on the Florida west coast between Cedar Keys and the Suwannee River. Simpson (*8*) in 1893, stated that he found several hundred shells in a heavy hammock north of the Manatee River, and that he also found the snail near Cunningham in Volusia County. In 1906, Sellards stated that the snail ranged as far north as the St. Johns River and south to the Caloosahatchee River. Pilsbry (*6*) lists the snail in Alachua, Duval, Marion, Webster, Manatee, Lee and Highlands counties. A variety *albidus* was created by Wright (*10*) from collections near Fatio in Volusia County, but considerable question is cast upon the validity of such a classification. In 1948, the author observed *D. dormani* in citrus groves in Lake, Sumter, Hernando, and Marion Counties and has reliable reports of its presence in groves near DeLand in Volusia County. To the

[1] Italic figures in parentheses refer to Literature Cited.

writer's knowledge, this species has not been reported south of Lake Okeechobee, and its range is confined to Florida. Pilsbry (*6*) stated that *dormani* is an apparent descendant of a Mexican species, and that it probably migrated to Florida via the southern United States in Pliocene times. It is, apparently, not closely related to any West Indian species.

BIOLOGY IN CITRUS GROVES

In discussing a generalized land snail, Binney (*2*) stated that they were usually vegetarians, that they laid their eggs in summer in the soil, and that they tended to be especially active at night or after a shower. During winter they hibernated by secreting a membrane-like structure, the epiphragm, across the opening of the shell. These generalities appear to fit *D. dormani* very well. Oviposition has been found to occur in the early part of the summer months. The onset of oviposition may vary from year to year, but it apparently extends over a period of six to eight weeks. In 1946, oviposition was well started by June 1; in 1947, it was delayed until about June 25; and in 1948, only a few eggs were seen by June 17. The onset of oviposition is probably partially determined by the onset of warm weather in the spring. However, there was an early spring in 1948, and the snails became active as early as February, but this did not result in early oviposition. This may have been due to the extremely dry weather which was experienced in May and June of 1948.

The eggs are laid in groups which vary from only a few to as many as 30, 40 or more. Since they are semi-buried, it appears that some effort is made to deposit the eggs so that leaves or other trash will partly cover them. They are laid near the base of a tree and the author has never observed them more than a few inches away from that general area. No data has been obtained on the necessary incubation period. There may be over a hundred eggs at the base of a tree and when they hatch, the lower part of the tree trunk may be literally covered with tiny snails measuring less than 2 mm. in diameter.

So far, the length of time required to reach maturity and the total life span have not been determined. Some evidence appears to indicate that the snails live at least three years, and possibly longer. They attain a maximum size such that the shell measures almost three centimeters in length. Tryon (*12*) suggests that terrestrial snails usually require two years to

reach sexual maturity and that they live 6 to 8 years in captivity. Whether this applies to *D. dormani* will have to be further investigated.

The densities of the snail populations in the groves under observation have fluctuated from year to year. Heavy populations might occur for one or two years, and then this would be followed by a low population for the next year. The trees attain a slick appearance due to the feeding activities of the snails and an idea of the number of snails present may be calculated by the date when the trees are cleaned up. Where snails are common, this has been observed as early as mid-July, but when few snails are present, it has been delayed until as late as November. Mortalities are often heavy during the winter or fall months. In one grove there was a heavy population in October, but they died off before cold weather and very few snails lived to go into hibernation. During November and December, it was almost impossible to find a live snail in the grove. Cold weather may sometimes be a factor, but in this latter instance snail mortality cannot be attributed to low temperatures. Lack of food may have been a factor since the trees were free of sooty mold by mid-July. For the present, however, the reasons for the marked population changes from year to year must remain unexplained.

The snails usually go into hibernation in December. They seek shelter in cracks and crevices in the trees and under trash at the base of the trees. A few, however, remain on the foliage or on exposed limbs and go dormant there. They secrete a membrane-like structure (the epiphragm) across the opening of the shell, and securely attach themselves to some substratum. They remain there until warm weather, when they appear to become active at about the same time that the trees begin to grow.

EFFECTS OF SNAILS IN GROVES

The food habits of this snail have not been fully determined. Binney (*2*) states that land snails are largely vegetarians, and Pilsbry (*6*) describes a related species which feeds on minute algae on the trees. *D. dormani* obviously eats sooty mold, and it would appear that this was its main food source. Large lichens on the limbs and trunks and entomogenous fungi on white flies are not eaten, but green algal growth is removed from the wood. In the late summer and fall of the year, all the sooty mold may be gone so that the trees appear to have been

oiled. The leaves are slick and glossy, and the wood is smooth and clean. The appearance of the wood is quite characteristic and at any season will serve as an easy guide to the trees which have or have recently had snail infestations.

In 1906, Sellards (*7*) discussed the fact that *D. dormani* removed sooty mold. In fact, this was what made the snail a valuable ally at the turn of the 20th century. At that time fruit was not regularly washed and then packed as is the case today. It was simply picked, put in a barrel, and shipped north. The advent of the whitefly and its attendant sooty mold forced the citrus man to wash his fruit before packing it. This added a new and expensive operation. However, where the snails had first cleaned the fruit, the washing was unnecessary. It is easy to understand why growers desired to maintain snails in their groves. The situation facing the grower today is entirely different, and different evaluations must be made of the snails and their cleaning activities.

Some citrus growers believe that the snails actually eat the scale insects on the trees, but the author has found no justification for such a claim and Norris (*5*) stated that it was doubtful that they ate scales. Purple and red scale populations have been checked at regular intervals in three groves with snail populations for more than two years. During that same period, scale infestations were checked in other groves on similar pest control programs. In these groves, zinc, copper and oil sprays were not used and only sulfur was applied. The data are too extensive to reproduce here and definite conclusions must await additional study. However, some of the groves had relatively heavy purple scale infestations and some had very light ones. Groves with and without snails were in both categories, and it could not be concluded that there were any less scales in the snail infested groves. Florida red scales were not a problem in any of them. In snail infested groves, a number of leaf samples were divided as to those which had been cleaned of sooty mold by the snails and those which had not. Less purple scales were found on the clean leaves. The author cannot conclude that the scales were removed by the snails, but rather that the lack of residue was the important factor and that as suggested by Thompson (*11*) and Holloway (*4*), purple scale is more prevalent in the presence of inert residues. It is possible that clean leaves may be a factor in maintaining low scale infestations, and therefore that snail infested groves would be

expected to have less scales than other groves. Whether this be true or not, scale insect infestations could not be considered to have been a limiting factor in any of the groves involved.

No claims have been made by growers for the control of other citrus insects. In general, it has been noted that insect populations were similar in groves both with and without snail populations when these groves were not sprayed with compounds of zinc and copper, and with an oil emulsion. Thus, there were usually low scale and purple mite infestations and sometimes high rust mite incidence. These conditions are undoubtedly related to the fact that a biological balance has been attained such that scales and purple mites do not usually produce excessive injury. It is however, necessary to apply some sulfur if the grower wishes to produce fruit free from rust mite injury.

The problem of melanose should also be considered. Although no copper was sprayed in any of the snail-populated groves discussed above, the author did not observe serious melanose infection on oranges in either 1946, 1947, or 1948. Excessive melanose was noted on grapefruit in one of the groves. Although snails have been collected in abundance from the dead wood, and it is possible that they may eat melanose spores, no actual evidence of such has been obtained. It must also be noted that snail activity is at a minimum during the spring, when melanose control would be essential. Populations are low at that time, and there is little evidence of any cleaning activity.

YIELD AND COST OF PRODUCTION DATA

It is difficult to obtain accurate production records and also difficult to get the proper groves for comparisons. Table 1 shows yield and cost data for three groves in Marion County. All are close together and are operated by the same production man. The one with snails is the oldest and the trees are definitely larger than in the other two. All three are on virtually identical fertilizer and pest control programs. Costs for these groves and for those discussed below have been calculated on the basis of standard fertilizer material costs given the author by different concerns; standard dealer insecticide prices; and ¾ cent per gallon for the application of sprays and 1½ cents per pound for the application of dusts. In addition, miscellaneous charges include discing, chopping, and fertilizer distribution, all at $1.25 per acre, and taxes at $12.00 per acre. No pruning, irrigation, depreciation, etc., are included. Table 1 indicates

that the presence of snails neither reduced the cost of production nor increased the yield in the groves considered.

TABLE 1.—A COMPARISON OF YIELD AND COST OF PRODUCTION IN THREE GROVES WITH THE SAME FERTILIZER AND PEST CONTROL PROGRAMS.

Variety	Pineapple		Parson Brown		Mixed Pineapple and Parson Brown	
Snails	No		No		Yes	
Year	Boxes per Tree	Cost per Box	Boxes per Tree	Cost per Box	Boxes per Tree	Cost per Box
1943	6.9	.....	3.8	.....	5.1	.....
1944	5.9	.....	3.6	.....	5.2	.....
1946	6.9	17¢	5.7	17¢	6.6	18¢
1947	3.7	29¢	5.9	17¢	6.1	25¢
Average	5.9	23¢	4.8	17¢	5.8	21½¢

Table 2 compares yield and cost data for two groves in Lake County. Both are old groves and are situated within a few miles of each other on the west side of the same lake. Both are cared for by the same cooperative association and have similar cultural and fertilizer practices. However, Grove A has no snails and is on a complete spray program which included the use of zinc, copper, DN, sulfur, and an oil emulsion while Grove B has snails and is treated only with dusting sulfur. The groves are both interplanted with various varieties and are essentially comparable. However, in Grove A, only 22 per cent of the trees are seedlings and grapefruit, while in Grove B, 37 per cent of the trees fall into these two varieties. In spite of this differential, Grove A has averaged almost twice as much fruit per acre as Grove B during the past three years. The fruit has cost more to grow on a per box basis with the discrepancy caused by the difference in spray and dust costs. It will be noted that although spray costs averaged 11 cents more per box in Grove A, miscellaneous charges averaged 4 cents per box less. This latter figure represents fixed charges, but does not include depreciation, interest on investment, etc. The cost per box for such fixed overhead is directly tied up with yield and decreases

TABLE 2.—A COMPARISON OF YIELLD AND COST DATA FOR TWO SIMILAR GROVES.

Year	Grove A — No Snails *						Grove B — Snails **					
	Boxes per Tree	Boxes per Acre	Cost per Box				Boxes per Tree	Boxes per Acre	Cost per Box			
			Fert.	Spray	Misc.	Total			Fert.	Spray	Misc.	Total
1945	4.0	338	21¢	14¢	6¢	41¢	3.1	225	25¢	2¢	9¢	36¢
1946	5.1	435	20	15	5	40	2.1	209	23	2	10	35
1947	5.3	452	12	11	4	27	3.6	260	12	2	8	22
Average ..	4.8	408	18¢	13¢	5¢	36¢	2.9	231	20¢	2¢	9¢	31¢

* Spray program includes use of DN, Zn, Cu, S, and oil.

** Pest control program consists of S dust only.

materially as yields increase. Although Grove B grows cheaper fruit, its yield is materially reduced and fixed charges are of greater significance in figuring costs.

Figures on the per cent of fruit sent to the cannery from each of these two groves are available for comparison in only three years. In 1943 and 1944, there was very little difference (See Table 3), but the per cent was slightly in favor of the sprayed grove. In 1947, when grades were considerably tighter, there was a striking difference in favor of the grove without snails.

TABLE 3.—A COMPARISON OF THE PER CENT OF FRUIT SENT TO THE CANNERY.

Variety	1943		1944		1947	
	Grove A	Grove B	Grove A	Grove B	Grove A	Grove B
Parson Brown	11	0	12	31	11	....
Seedling	20	34	49	41	53	81
Pineapple	27	37	35	49	33	95
Valencia	24	21	12	12	42	58
Average	21	23	27	33	43	76

No sweeping conclusions may be drawn from the yield and cost data presented here. Tendencies are evident, but more information is needed. There is certainly no evidence here to indicate that snail infested groves have yielded material benefits to their owners. Apparently, the snails do no harm, and when a grower does not wish to use a complete spray program, it is possible that they are of some benefit. However, this conclusion is not substantiated by any data collected by the author.

SUMMARY AND CONCLUSIONS

The activities of the snail, *Drymaeus dormani,* were studied in citrus groves in Florida for more than two years. Eggs were laid in June and July and hatched in July and August of each year. The snails hibernate in crevices and cracks in the trees during the winter months.

The snails feed on sooty mold and green algae on the trees. No evidence was found to indicate that they feed on infesting purple or Florida red scale populations. Scale infestations in

snail groves were similar to those found in other nearby groves on similar pest control programs.

Cost and yield data for three groves on identical pest control programs did not show increased yield or decreased costs due to the presence of snails.

Cost and yield data from two similar groves, one with snails on a sulfur dust program, and one without snails on a complete spray program, showed that the grove with the complete spray program produced almost twice as much fruit per acre for a little more cost per box. Less fruit went to the cannery from the sprayed grove.

No detrimental effects of snails were noted, but data collected, so far, does not support the reported benefits attributed to snail populations in the grove.

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