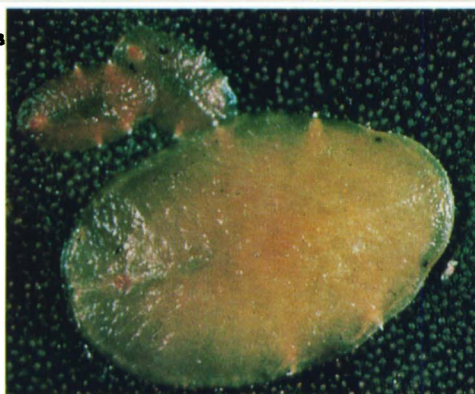




Leaves of iceplant heavily infested by immature scales.



Iceplant is used to landscape thousands of miles of California highways.



Settled crawlers and nymph of iceplant scale, greatly magnified.



Adult female scales (with ovisacs), and maturing females, on iceplant.

Scales threaten iceplant in Bay Area

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For many years iceplant has served as a completely satisfactory groundcover on residential grounds, commercial sites, and especially along steep highway and freeway cuts as well as interchanges and divider strips. With the exception of weed problems early in the life of plantings and occasional freezing injury, iceplant has been relatively free of the insects, plant diseases, and other disorders so injurious to many other ornamentals. In the past few years, however, a complex of scale insects of the genus *Pulvinaria* has assumed major importance on this groundcover in the greater San Francisco Bay area.

Pulvinaria on iceplant was first discovered in 1971 at Napa and Oakland. Seven

additional counties had reported the scales by 1978. According to entomologist Ray Gill, California Department of Food and Agriculture, these infestations consist of two species of *Pulvinaria* which differ little morphologically but significantly in their life cycles. At the date of this writing, *Pulvinaria mesembryanthemi* (Vallot) is known to occur in Napa, Solano, Alameda, Contra Costa, and Marin counties, and *Pulvinaria* sp. (as yet unnamed to species) in Alameda, Contra Costa, San Mateo, Santa Clara, Santa Cruz, and Monterey counties.

Biological studies

Studies were initiated early in 1977 to compare the seasonal activity and other attri-

butes of the two species. Collections and measurements of specimens were made periodically from populations at Napa and Oakland where *P. mesembryanthemi* and *Pulvinaria* sp., respectively, were known to occur.

Scales from Oakland were found to have only a single generation each year (fig. 1). Overwintering occurred in the mature female stage, with the ovisac (egg sack) stage present beginning about January 1 and extending until the end of May. The new generation of crawlers, from eggs deposited in the ovisac, was first detected in late March 1977. The Napa *Pulvinaria* scale population, on the other hand, cycled twice annually, with ovisacs present from late April to late

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July, and again from early September until early the following February. Crawlers were first seen in late May and again in early October. As many as 1900 eggs per ovisac were found at Oakland but never more than 700 were counted at Napa.

Male scale puparia were noted in May and again in August at Napa, but were never found in Oakland despite the many observations made there. Parasitization of iceplant scales by *Coccophagus lycimnia* was noted almost year-round at Napa, yet extremely low levels of parasitism at any season were detected at Oakland. *Rhizobiellus ventralis*, a beetle predaceous on soft scale insects, was found feeding on iceplant scales at both locations.

The effect of *Pulvinaria* on the well-being of its iceplant host is not yet completely clear. Declining and dead plants were found associated with heavy scale infestations at both locations. The extremely dry growing seasons of 1976 and 1977 and freezing temperatures may also be associated with some decline of iceplant not infested by iceplant scale.

Chemical treatment trials

Before the initiation of biological studies, three chemical control trials were conducted in 1976 and 1977 in the Napa area. A high level of control can be achieved when insecticide applications are properly timed to reach the crawler or nymphal stages of the scale. The adult female scale and eggs are very tolerant to treatments. Eggs are arranged between waxy filaments that cover,

wrap, and protect them within the ovisac.

Trials included single and double spray treatments timed to coincide with nymphal stages. Because phytotoxicity was apparent from the high rate of 2 percent oil used, a trial was made at the reduced rate of 1 percent Volck oil. Other adjuvants were tried also.

All trials included five replications of all treatments in randomized blocks. Each plot consisted of 100 feet squared of iceplant. The great density of iceplant makes thorough coverage difficult. In an attempt to achieve a high level of control, a volume of 400 to 500 gallons per acre was used with a sprayer pressure of 200 pounds. The selection of materials in the trials was based on a known history of insecticidal activity for the control of scale insects. However, ammonium sulfate was included because it is often applied to iceplant for weed control and as a fertilizer.

Results

Several materials in combination with either Volck and Spectrum 415 oils or Amway adjuvant showed good control potential. Volck oil at 2 gallons per 100 gallons of water plus either diazinon or malathion gave good results (table 1). In a double application trial not shown here (two applications were made seven weeks apart), excellent control of scales was obtained with the above combinations. Sevin plus oil and Supracide without oil gave comparable results. The problem of phytotoxicity, when using the high rate of 2 percent oil, was solved by reducing the amount used to 1 percent, with no

sacrifice to scale control (table 2). In addition, this trial showed that comparable efficacy was obtained by using combinations of Amway adjuvant, instead of oil, with Sevin or diazinon.

Work remaining

Despite progress made thus far, much remains to be learned about these scales. The complete host range of each species is not known although there are reports from Berkeley of *Pulvinaria* on *Crassula* and *Sedum* in addition to iceplant.

Iceplant and its *Pulvinaria* scales apparently are native to Africa. Importing natural enemies from Africa and releasing them in California could reduce the insect to tolerable levels. The coastal location of all counties in which the scales have been collected in California opens the question of how far inland the insects are capable of surviving. The California Transportation Department maintains approximately 6,000 acres of iceplant statewide with an estimated replacement value of \$20,500,000. In addition, probably that much acreage exists on private and other lands, so the potential is great for a widespread, serious problem. Finally, the levels of scales that can be tolerated on iceplant without decline or apparent disfigurement of the plant have yet to be determined.

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Fig. 1. Seasonal activity and average size of 100 iceplant scales in Napa and Oakland.

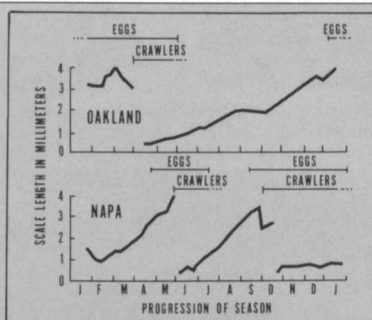


TABLE 1. Effect of a Single Spray Application on Control of Iceplant Scale, *Pulvinaria mesembryanthemi*. Applied March 5, 1976—Napa

Material and formulation	Amount of formulation per 100 gals.	Scales* alive per 30 leaves		
		Mar. 22	Apr. 6	May 13
Supracide 2 EC	2 pt.	95	2	5
Meta-Systox R 2 EC	4 pt.	109	111	79
Cygon 2 EC	4 pt.	55	114	47
Volck Oil	2 gal.	148	93	160
Lorsban 4 EC + Volck Oil	1 pt. + 2 gal.	0	66	17
Malathion 4 EC + Volck Oil	4 pt. + 2 gal.	45	0	3
Diazinon 50 WP + Volck Oil	2 lb. + 2 gal.	3	4	0
Sevin 50 WP + Volck Oil	2 lb. + 2 gal.	0	0	81
Ammonium Sulfate 21-0-0	60 lb.	303	185	142
Untreated Check	—	579	607	370

TABLE 2. Evaluation of a Single Spray Application for Control of Iceplant Scale, *Pulvinaria mesembryanthemi*. Applied November 5-6, 1976—Napa

Material and formulation	Amount of formulation per 100 gals.	Scales* alive per 30 leaves		
		Nov. 19 1976	Dec. 16 1976	Feb. 8 1977
Supracide 2 EC	2 pt.	28	3	0
Supracide 2 EC + Spectrum 415 Oil	2 pt. + 1 gal.	16	2	4
Diazinon 50 WP + Volck Oil	2 lb. + 2 gal.	13	14	3
Diazinon 50 WP + Volck Oil	4 lb. + 1 gal.	26	19	6
Diazinon 50 WP + Spectrum 415 Oil	2 lb. + 2 gal.	40	8	2
Diazinon 50 WP + Spectrum 415 Oil	4 lb. + 2 gal.	21	7	1
Diazinon 50 WP + Spectrum 415 Oil	4 lb. + 1 gal.	11	5	2
Diazinon 50 WP + Amway Adjuvant	4 lb. + 1 pt.	29	10	0
Sevin 50 WP + Volck Oil	4 lb. + 1 gal.	44	20	1
Sevin 50 WP + Spectrum 415 Oil	4 lb. + 2 gal.	118	0	3
Sevin 50 WP + Amway Adjuvant	4 lb. + 1 pt.	24	28	8
Untreated Check	—	194	150	397

*Pre-treatment count on Nov. 4, 1976, ranged from 310 to 912 scales per 30 leaves.

*Pre-treatment count on March 5 ranged from 400 to 1266 scales per 30 leaves.