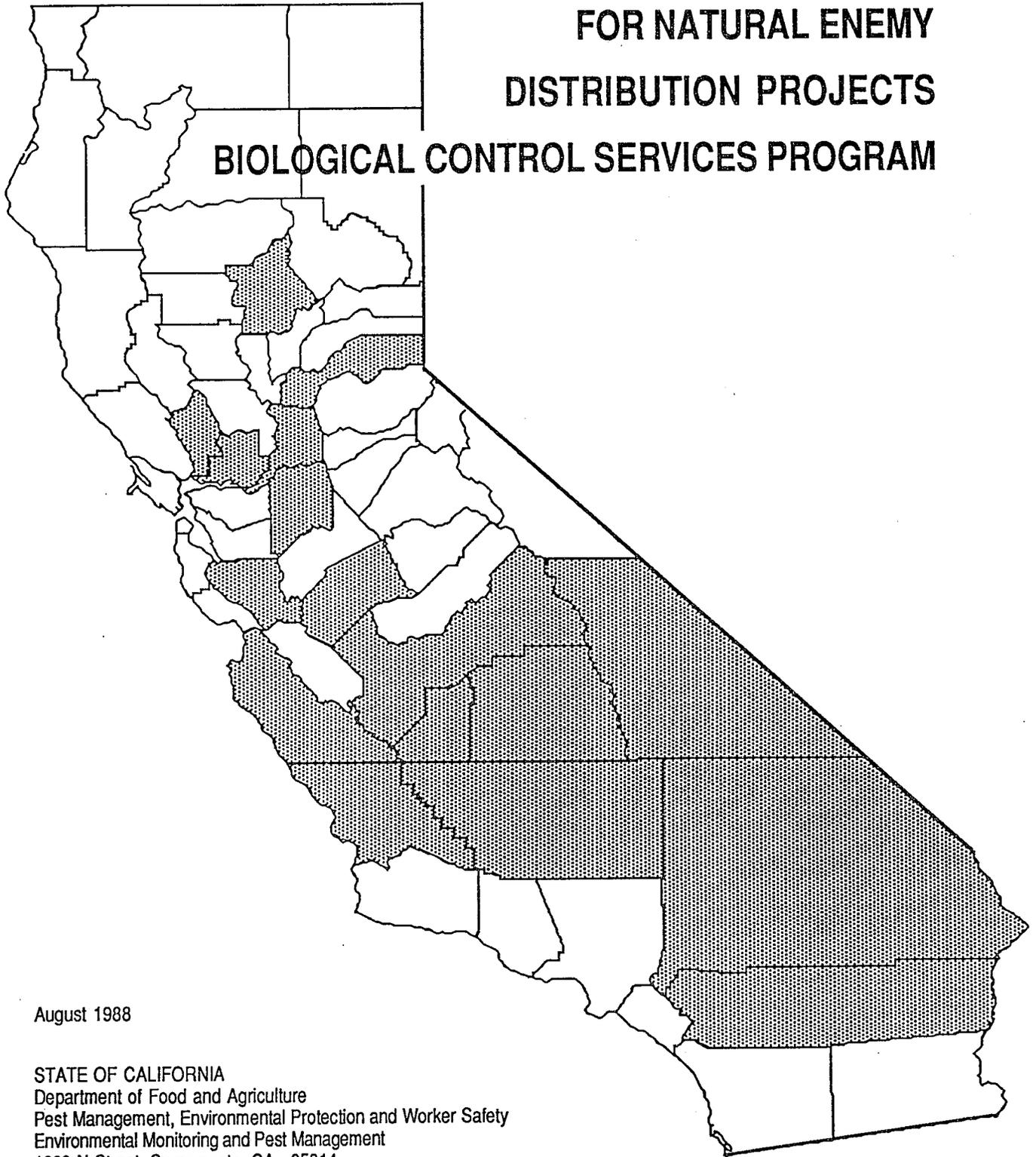


**1987 PROGRESS REPORT
FOR NATURAL ENEMY
DISTRIBUTION PROJECTS
BIOLOGICAL CONTROL SERVICES PROGRAM**



August 1988

STATE OF CALIFORNIA
Department of Food and Agriculture
Pest Management, Environmental Protection and Worker Safety
Environmental Monitoring and Pest Management
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**1987 PROGRESS REPORT
FOR NATURAL ENEMY DISTRIBUTION PROJECTS**

by

L. Bezark

with B. Villegas, J. Ball, K. Casanave

August, 1988

BIOLOGICAL CONTROL SERVICES PROGRAM

EXECUTIVE SUMMARY

This report summarizes field releases of natural enemies made by personnel of the Biological Control Services Program (BCSP) during 1987. Also included are releases made by county agricultural commissioner personnel or staff of the University of California in connection with projects funded through BCSP contracts.

In 1987, releases of natural enemies were made in 17 counties throughout the state (shaded areas on the cover). Fourteen different natural enemies were released to aid in the control of five destructive insects and two noxious weed species. During the season, over 25,000 individual natural enemies were field collected or reared in laboratories and greenhouses and released into areas with high populations of the targeted pests.

Releases were made on comstock mealybug, European asparagus aphid, woolly whitefly, western grapeleaf skeletonizer, eucalyptus borer, waterhyacinth and puncturevine. Planned releases for yellow starthistle, tansy ragwort and citrus and cloudywinged whiteflies were not made due to the lack of availability of natural enemies. Work on these pests will continue in 1988.

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The map and cover were prepared by Linda Heath (Thanks Linda!).

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TABLE OF CONTENTS

	Page
Executive Summary	i
Acknowledgements	ii
Disclaimer.....	ii
Table of Contents	iii
List of Tables	iv
Introduction	1
Insects	4
Comstock mealybug	4
European asparagus aphid	5
Woolly whitefly.....	6
Western grapeleaf skeletonizer	8
Eucalyptus borer	18
Weeds	20
Waterhyacinth	20
Puncturevine	25

INTRODUCTION

The use of conventional chemical methods to control insect and weed pests requires costly repeated applications to maintain acceptable levels of control. The use of chemicals may have adverse effects on the environment and may be of concern to human health and safety. For some pests, biological control methods can be implemented as an alternative strategy or as an adjunct to chemical methods.

The goals of the Biological Control Services Program (BCSP) are to reduce pesticide exposure to people and the environment through the development and use of natural enemies as alternatives to pesticides, and to provide pest control methods that are efficient and reduce dependency on chemicals.

A primary focus of the BCSP is classical biological control. Classical biological control involves the importation of exotic natural enemies to control pest populations. Most pest insects and weeds become pests simply because they are introduced to geographic areas that are free of the parasites or predators that control the pest in its native habitat. The first step in importation of biological control organisms is to determine the country of origin of the pest in question. Research in the native home of the pests centers around those natural enemies which are effectively maintaining the pest population at low non-economic levels. Once target organisms have been identified, they are subjected to several host specificity trials to ensure that these beneficial organisms will not feed on economically or ecologically important species. After determining that the natural enemies are specific, they can be collected and subsequently transported to the areas with high pest levels. Populations of

both the pest and its introduced natural enemies are then monitored to determine that the natural enemies have become established and to verify that they are indeed having an impact on the pest. Finally, redistribution of natural enemies can occur as populations of both pests and natural enemies fluctuate.

In 1987, the BCSP made natural enemy releases on seven pest species in 17 counties statewide (Figure 1). Over 25,000 parasitoids were released into the field to control the populations of these harmful pests. Releases were made on comstock mealybug, European asparagus aphid, woolly whitefly, western grapeleaf skeletonizer, eucalyptus borer, waterhyacinth and puncturevine. Planned releases for yellow starthistle, tansy ragwort and citrus and cloudywinged whiteflies were not made due to the lack of availability of natural enemies. Work on these pests will continue in 1988. Individual accounts of the pests and natural enemy releases follow.

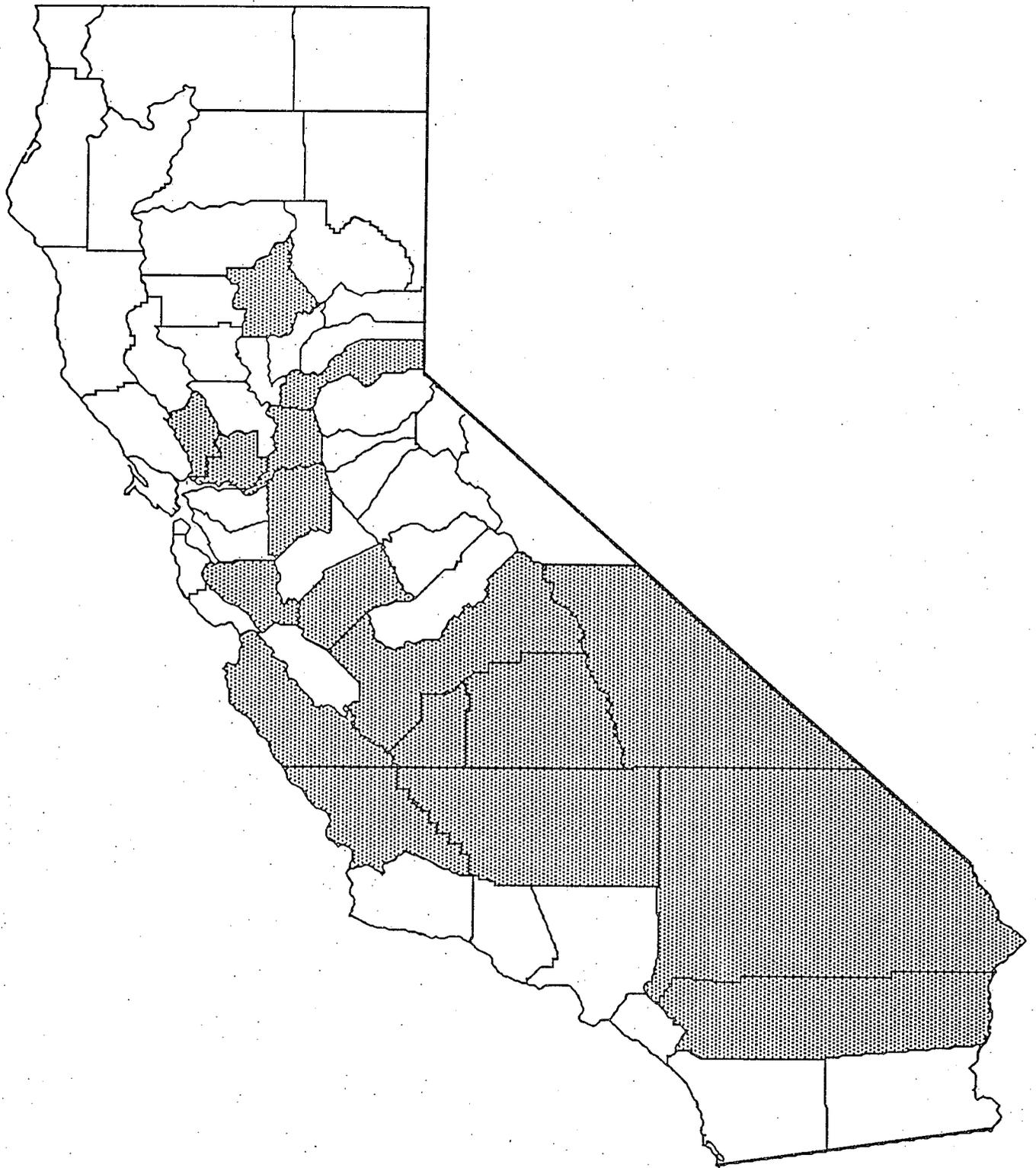


Figure 1. Counties in which releases of natural enemies were made.

INSECTS

COMSTOCK MEALYBUG

The comstock mealybug (CM), Pseudococcus comstocki (Kuwana), is a pest of mulberry and sometimes citrus; damage results from sap removal by the insect's feeding and also from the fungal growth that accompanies the large amounts of honeydew excreted. In 1987, this pest was found in Corcoran, Kings County, and a request was made to the BCSP to release natural enemies. Although this was the first known infestation in Kings County, CM and its parasitoids were known to occur in adjacent Tulare County, in Lindsay, Exeter and Visalia. Parasitoids of CM were not in insectary production, and therefore had to be field collected. Personnel of the Tulare County Agricultural Commissioner's office assisted in locating properties where the mealybug and its parasitoids could be collected.

Results: During 1987, two parasitoid collections and subsequent releases were made. On September 2, 1987 small collections of approximately 200-300 parasitized CM were made in Lindsay and Exeter and placed in an infested tree in Corcoran to await emergence. On September 16, 1987 a second collection estimated to contain 3,000 parasitoids was taken almost entirely from one tree in Visalia, and placed for emergence at two additional sites in Corcoran.

The parasitoids released were, Pseudaphycus melinus Gahan, an encyrtid wasp, Allotropa sp., a platygasterid wasp, and an unidentified parasitoid in the wasp family Encyrtidae. The estimated number of parasitoids released may not be accurate because at the time of collection, it was difficult to separate the different host stages, such as those parasitized, those not parasitized, and those from which parasitoids had already emerged.

A sample of 500 hosts taken 10 days after the last release, showed no signs of parasitization, although recovery was not expected at that time. Additional releases are anticipated in 1988.

EUROPEAN ASPARAGUS APHID

Since its introduction into California in 1984, the European asparagus aphid (EAA), Brachycorynella asparagi (Mordvilko), has become established throughout the state. This aphid has the potential to cause severe damage to asparagus spears by injecting a toxin while it feeds. The toxin causes the plant to become stunted and then produce inferior spears. To combat this pest, a parasitoid in the wasp family Aphidiidae, Diaeretiella was introduced from Switzerland by personnel of the University of California in 1986, and established in insectary culture at the Kearney Field Station, Parlier. On May 21, 1987, the BCSP received 50 adult parasitoids (originally from Switzerland) from the Parlier culture, to establish an insectary colony at the Meadowview Laboratory facility, Sacramento.

Results: Several releases of Diaeretiella were made from the Meadowview colony against populations of EAA at several sites (Table 1).

Table 1. Release record of Diaeretiella on European asparagus aphid.

County	Site	Date	Numbers	Notes
Sacramento	Freeport 1	8/5/87	125	80' asparagus bed, heavy EAA
	Freeport 2	8/7/87	88	2, 80' rows, heavy EAA
	Sacramento 1	8/27/87	50	4 rows, 10 crowns per row heavy EAA
	Sacramento 2	9/11/87	100	bed 100' X 50' light EAA bean aphid also present
	Sacramento 1	10/7/87	156	second release
Solano	Ryer Island	9/10/87	271	volunteer asparagus plants along road, EAA light, colonies widely dispersed

Diaeretiella was recovered from EAA mummies at the Sacramento 1 site, however it is not known if the recovered material represents the Switzerland strain or a previously established strain. The two strains currently cannot be distinguished from one another.

WOOLLY WHITEFLY

Woolly whitefly (WWF), Aleurothrixus floccosus (Maskell), is a pest of citrus. The pest's extensive feeding results in heavy honeydew production and subsequent fungal growth which affects the marketability of fruit. In 1987, the BCSP was involved with the release of parasitoids against new infestations of WWF in San Luis Obispo and Santa Clara counties.

Results:

San Luis Obispo: The only known infestation within the county was in the town

of San Luis Obispo. On May 14, 1987, a pre-release survey performed by our program and county personnel, was unable to locate live WWF colonies; old colony remnants showed evidence of parasitoid emergence. In the week following the survey, county personnel released an unknown number of parasitoids (Amitus spiniferus (Brethes), a platygasterid wasp, and Cales noacki Howard, an aphelinid wasp) that had been obtained prior to the survey.

On September 24, 1987, another joint survey was conducted. Infested citrus trees were uncommon, but after lengthy visual search, samples were eventually collected from eight properties. Examination of the samples disclosed good parasitization of the current WWF generation (Table 2). Because of the low level of infestation and the distribution of parasitization, it was felt that the parasitoids were well established in the area and that additional parasitoid releases would be unnecessary.

Santa Clara County: Woolly whitefly was first reported in San Jose on August 21, 1987. Personnel from the BCSP met with county representatives to observe the infestation and discuss implementation of biological controls. From September 30 to October 2, 1987, a survey in the immediate vicinity of the known infestation was conducted. Leaf samples were collected to determine parasitization, cooperating homeowners were contacted to secure properties for the parasitoid release program, and initial parasitoid releases were made.

Sample citrus leaves to determine parasitization were collected from six properties. WWF infestations were quite heavy on the citrus sampled; averaging 31 late instars per half leaf. No parasitized WWF were found nor was there evidence of parasitization of previous generations.

On October 6 and October 8, 1987, parasitoids obtained from the University of California, Riverside were released on two properties. The number of parasitoids was quite low, so only 131 C. noacki and 19 A. spiniferus were released between the two properties. Samples to determine establishment will be taken in 1988.

Table 2. Parasitization of woolly whitefly in San Luis Obispo.

Site	No. Leaves Inspected	# WWF/ Leaf	Percent Parasitism*	No. Leaves w/o Parasitoids
Johnson	5	49	55	0
Crestview 1	6	88	36	1
Crestview 2	6	31	55	0
Peach and Islay	5	41	65	1
Combined Sites **	7	17	34	2

* 3rd and 4th WWF instars only

** Combined sample from Lizzie, Cazadero, Hathaway, and San Luis Obispo Mission

WESTERN GRAPELEAF SKELETONIZER

The western grapeleaf skeletonizer (WGLS), Harrisina brillians B. & McD., is a pest of commercial and backyard grape plantings. Larvae of this zygaenid moth species feed on the soft leaf tissues, leaving only the veins intact and when populations are high they feed on the grape clusters as well. In 1987, two species of biological control agents, a tachinid fly, Ametadoria misella (Wulp), and a braconid wasp, Apanteles harrisinae Muesebeck, were released in several locations (Table 3).

Parasitized WGLS material was collected from two vineyards located in San Diego County during July and September. Once collected, the material was transported to the BCSP quarantine laboratory in south Sacramento for subsequent redistribution to the release locations. The wasp was released onto young WGLS

larvae (1st through 3rd instar) while the tachinid fly was released onto older WGLS larvae (3rd through 5th instar). Colonization by Apanteles was determined by examining WGLS pupae/cocoons for the presence of Apanteles cocoons. Colonization by Ametadoria was determined by either examining the prothoracic region of a WGLS pupa for the presence of the protruding anal spiracle of the fly maggot, or by locating a fly puparium inside the WGLS pupa.

NATURAL ENEMY RELEASES/RESULTS

During the 1987 season, a total of 208 releases, totalling 5,175 flies and 8,897 wasps, were made at 53 sites located in 10 counties throughout California. Parasitization rates refer to the percentage of the total number of pupae examined that were parasitized.

Table 3. Natural enemies released against western grapeleaf skeletonizer in California during 1987.

County	No. Sites	Releases	<u>Ametadoria</u> Flies	<u>Apanteles</u> Wasps
Butte	1	2	126	8
Fresno	11	22	1,153	153
Inyo	3	16	592	224
Kern	2	2	100	0
Kings	1	2	69	3
Placer	1	2	20	40
Sacramento	4	28	335	1,728
San Bernardino	17	35	1,695	1,080
San Luis Obispo	11	97	936	5,661
Tulare	2	2	149	0
TOTAL:	53	264	5,175	8,897

Butte County:

On June 17, two releases consisting of 126 flies and 8 wasps were made at one site in Oroville. This is the third year of parasitoid releases in Butte County.

From the first WGLS generation, twelve samples were collected from five sites in Oroville. Both parasitoids were recovered with flies accounting for 64.7% parasitization and wasps for 11.3% parasitization. Only two small samples were obtained from the second WGLS generation. Only flies were recovered from these samples and accounted for 77.8% parasitization.

Fresno County:

Parasitoids were released from July 1 to September 22. The parasitoids were moved from sites where they were well established and presumably adapted, to areas where the parasitoids either had not been recovered or had been recovered in very low numbers in previous seasons. A total of 22 releases consisting of 1,153 flies and 153 wasps were made at 11 sites (Table 4.). With the exception of the Herndon releases (115 flies), all parasitoids released emerged from collections made from sites located in Fresno, Kern, and Tulare counties.

Table 4. Natural enemies released against western grapeleaf skeletonizer in Fresno County during 1987.

County/City	No. Sites	Releases	<u>Ametadoria</u>	<u>Apanteles</u>
			Flies	Wasps
Clovis	4	12	432	151
Fresno	5	8	507	2
Herndon	1	1	115	0
Malaga	1	1	99	0
TOTAL:	11	22	1,153	153

In 1987, a county-wide natural enemy survey was made in order to determine levels of parasitization by Ametadoria and Apanteles. Overall, the parasitization data gathered shows low parasitization levels by both parasitoids throughout the infested areas of Fresno County. Following is a summary of the parasitization by city:

Clovis: Six sites were studied in Clovis. From the first WGLS generation, nine samples totalling 1,635 WGLS pupae were gathered from five sites. Only flies were recovered and the average parasitization was 7.9%. From the second WGLS generation, 12 samples consisting of 1,184 WGLS pupae from five sites were examined. Again, only flies were reared and the average parasitization was 14.5%.

Firebaugh: Only one small sample consisting of six WGLS pupae and belonging to the second WGLS generation was collected from one site on July 22. One fly was recovered.

Fresno: Twelve sites were studied in the city of Fresno. From the first WGLS generation, 24 samples totalling 944 pupae from 11 sites were examined. Flies were recovered at low levels with an average parasitization of 4.3%. Parasitization levels in the individual samples ranged from zero to 40.0%. From the second generation, 16 samples consisting of 803 WGLS pupae were gathered from eight sites and examined. Flies were recovered from 12 samples, with parasitization rates ranging from zero to 50.0% with an average parasitization of 15.4%. One sample yielded a single wasp.

Herndon: On July 21 and August 11, two samples consisting of 218 WGLS pupae were collected from a single site; no parasitoids were detected.

Malaga: From the second WGLS generation, three samples totalling 161 WGLS pupae were examined for parasitization, but no parasitoids were detected. From the third WGLS generation, two samples consisting of 101 WGLS pupae were also studied without recovering any parasitoids. All samples were taken from one site.

Parlier: One sample consisting of 60 WGLS pupae was gathered on July 24. No parasitoids were recovered.

Selma: On July 31, two samples from two sites totalling 185 WGLS pupae were gathered from the second generation. No parasitoids were recovered.

Inyo County:

Between June 22 and 24, a total of 592 flies and 224 wasps were released, at three sites in Bishop. The parasitoids were distributed in 16 separate releases. Additionally, on August 8, six cardboard strips, containing heavily parasitized WGLS material from San Luis Obispo County, were set out at one of the previous release sites in Bishop.

On June 9, pre-release samples consisting of four pupal collections and one larval collection were gathered from five sites. The samples were collected in order to determine baseline parasitization levels before natural enemies were released. No parasitoids were recovered from the 226 WGLS pupae contained in the five pre-release samples. Later, four post-release samples totalling 203 pupae were collected from the first WGLS generation after parasitoid releases were started in Bishop. The parasitization levels recorded averaged 39.4% for Ametadoria and 0.5% for Apanteles. Flies were recovered from all four samples while wasps were only recovered from one sample. During the second WGLS generation, six samples were gathered from four sites for a total of 228 WGLS pupae. The parasitization for this generation averaged 59.2% for Ametadoria and 6.1% for Apanteles. Recoveries from two successive generations indicates that good colonization of the parasitoids took place in 1987.

Kern County:

On September 8, two releases totalling 100 flies were made at one site in each of the cities of Delano and Shafter.

From August 3 to 16, seven samples belonging to the second WGLS generation were collected from four sites. Ametadoria was recovered from all seven samples with an average parasitization rate of 52.0%. On September 9, a larval sample belonging to the third WGLS generation from a previous release site was collected. Ametadoria was recovered and accounted for 37.1% parasitization.

Kings County:

On June 15, two releases totalling 69 flies and 3 wasps were made at a site in Avenal. Additionally, on August 7, four cardboard strips, containing heavily parasitized WGLS material from San Luis Obispo County, were set out at the same release site in Avenal.

On June 18, three pre-release samples totalling 147 WGLS pupae were collected from three sites and examined for parasitoid activity. Only one fly was recovered from one sample resulting in a parasitization rate of 0.7%. On October 15, two post-release samples were collected from the biological control release site. Ametadoria was recovered from one sample with a 4.2% rate of parasitization.

Placer County:

On August 21, two releases totalling 20 flies and 40 wasps were made at a site in Rocklin. No additional releases were made at this site during the season, as Ametadoria was recovered in high numbers from a pre-release sample taken on August 21.

In 1987, WGLS infestations were found at a site in Rocklin and at a 1986 release site in Penryn. Two small samples were taken from the Rocklin site on August 21 and on October 20. Only flies were recovered from the samples, and the parasitization was 40.1% and 75.0% respectively.

The appearance of WGLS at the 1986 release site in Penryn appears to have been caused by the application of pesticides by the homeowner. In 1986, excellent parasitization levels were found at the site along with little defoliation. A small sample of larvae was collected on October 20; no parasitoids were recovered.

Sacramento County:

From June 18 to September 2, 28 releases totalling 335 flies and 1,728 wasps were made at four sites in south Sacramento.

An expanding infestation, presumably from Elk Grove, was detected in a few residential properties in south Sacramento. Two small post-release samples collected on August 26 at two sites, were parasitized by the fly with rates ranging from 73.1% to 80.0%. Since there were no pre-release samples taken from this new infestation, we do not know if the high parasitization rate was due to a BCSP release or the natural spread by bioagents from nearby WGLS infestations.

San Bernardino County:

In 1987, two new infestations located in the cities of Barstow and San Bernardino were discovered. From August 12-19, a total of 1,587 flies and 998 wasps were released in 33 separate releases at 16 sites in Barstow. In the city of San Bernardino, two parasitoid releases totalling 108 flies and 82 wasps were made at one site on August 20. No additional parasitoid releases were made

because of the low WGLS population levels encountered at some of the sites and because of the lack of cooperative homeowners.

Parasitoid releases were facilitated by emergence containers and cardboard strips placed at eight new sites and at five ongoing release sites in Barstow and at the single release site in San Bernardino. The parasitized material was obtained from Butte, San Luis Obispo, and San Diego counties.

Barstow: On July 13, pre-release samples consisting of one pupal collection and two larval collections were gathered from two sites. The samples were collected in order to determine baseline parasitization levels before natural enemies were released. No parasitoids were recovered from the 180 WGLS pupae contained in the three pre-release samples. Thirty-nine post-release samples totalling 2,818 WGLS pupae were collected from the second WGLS generation after parasitoid releases were started in Barstow. The parasitization level averaged 7.7% for Ametadoria and 0.5% for Apanteles. Flies were recovered from 16 samples while wasps were recovered from six samples. Parasitization by Ametadoria ranged from zero to 48.9%, and parasitization rates of Apanteles ranged from zero to 19.0%

Lucerne Valley: On June 13, five samples consisting of 385 WGLS pupae from the first WGLS generation, were collected from two previous release sites and from a new location in Lucerne Valley. Ametadoria was recovered from the five samples. Parasitization rates averaged 30.4%, with rates ranging from 16.0% to 63.1%. Apanteles were recovered from a sample collected at a previous release site. In this sample the parasitization by Apanteles was 37.0%. Only one sample was taken from the second WGLS generation in Lucerne Valley. This sample was collected on August 14, from a previous release site; only Ametadoria was recovered from this sample, with parasitization at 17.3%.

San Luis Obispo County:

Between June 12 and July 30, a total of 936 flies and 5,661 wasps were released at 11 sites in Paso Robles. The parasitoids were released in 97 separate releases. Additionally, on August 7, emergence cardboard strips containing heavily parasitized WGLS material from other sites in Paso Robles were set out at two satellite infestations that were devoid of the parasitoids.

Atascadero: From the second WGLS generation, three samples totalling 159 WGLS pupae were taken from a non-release site. Ametadoria was recovered and the average parasitization was 27.0%. When this WGLS infestation was brought to our attention in July, 1986, no parasitoid releases were made, and we waited to see if parasitoid immigration would occur. Flies were recovered in the 1986 second generation samples and they continued to be recovered in 1987. It is presumed that Ametadoria probably emigrated from the Paso Robles infestation, located approximately 16 miles north of Atascadero.

Paso Robles: In 1987, WGLS infestations started to disappear from the Sierra Bonita housing development, which was thought to be the "core area" when the WGLS infestation was first detected by the San Luis Obispo County Department of Agriculture personnel in 1985. Weekly monitoring of the WGLS adult population with pheromone traps detected reduced moth flight below 1986 levels and very few active larval infestations in the core area. In 1987, most of the active infestations were detected in outlying areas away from the original core area.

From June 11 to August 6, 21 samples from 13 sites totalling 1,726 WGLS pupae were collected from the first WGLS generation. Both parasitoids were recovered. Ametadoria was recovered from 18 samples while Apanteles, was recovered from

nine samples. The average parasitization was 40.6% for Ametadoria and 9.6% for Apanteles.

From the second WGLS generation, six samples consisting of 701 WGLS pupae were collected from four sites. The average parasitization was 10.8% for Ametadoria and 0.1% for Apanteles. The significant drop in the parasitization level of the parasitoids is attributed to the fact that the samples were collected from outlying infestations outside the core area.

From the third WGLS generation, eight samples totalling 172 WGLS pupae were collected from both core and outlying sites. Both parasitoids were recovered. The average parasitization by Ametadoria was 32.6% while that by Apanteles was 16.9%.

Tulare County:

On August 24 in Porterville and on September 8 in Tulare, two releases totalling 149 flies were made.

In 1987, some sites in Tulare County were surveyed in order to determine levels of parasitization by Ametadoria and Apanteles. As in Fresno County, the overall parasitization data gathered from the study sites shows low parasitization levels. Following is a summary of the parasitization by city:

Ivanhoe: Seven larval samples collected on August 7, from three sites were examined for parasitoid activity. Ametadoria was recovered from five of the samples. Parasitization levels of the individual samples ranged from zero to 40.6%, with an average parasitization of 9.9%. Apanteles was not recovered from any of the samples.

Porterville: One larval sample consisting of 26 larvae was collected on August 25 and subsequently examined for parasitization. One fly was recovered from the sample for a 3.8% parasitization rate.

Visalia: Five samples were collected from three sites in Visalia. Both Ametadoria and Apanteles were recovered from two samples collected from the same site on July 2 and August 26. The parasitization by Ametadoria was 2.8% in the first sample and 4.6% in the second sample. The parasitization by Apanteles was 0.7% in the first sample and 0.5% in the second sample.

Woodlake: Two samples totalling 56 WGLS pupae were gathered on June 12 and on July 23 from two sites. No parasitoids were recovered.

EUCALYPTUS BORER

The BCSP currently has a research contract with the University of California at Riverside to import biological control agents to be used against the eucalyptus borer, Phoracantha semipunctata (Fabricius). This long-horned wood-boring beetle places its eggs just beneath the bark of several species of Eucalyptus and the larvae mine in the wood causing severe damage to stressed trees and eventually killing them. In 1987, biological control workers at the University received shipments of parasitoids and predators of the eucalyptus borer from Australia. Included were braconid and ichneumonid wasps and one species each of the beetle families Cleridae and Colydiidae. Pending approval for field release, the clerid is being reared in the laboratory. A field release in Riverside county of Syngaster lepidus Brulle, a braconid wasp, yielded no recoveries. Only a few individuals of each of the other biocontrols were

obtained; additional shipments of biological control agents are anticipated in 1988.

WEEDS

WATERHYACINTH

Waterhyacinth, Eichhornia crassipes (Mart.) Solms, is a rapidly growing aquatic plant in the pickerelweed family, which chokes off water flow in lakes, rivers and slow moving streams. An integrated pest management program against this weed in the Delta region of California has been under way since 1982. Since that time, two species of waterhyacinth weevils, the chevroned waterhyacinth weevil, Neochetina bruchi Hustache, and the mottled waterhyacinth weevil, Neochetina eichhorniae Warner, have been introduced into California and have become established.

Since 1984, the waterhyacinth moth, Sameodes albiguttalis (Warren), a pyralid, has been reared in BCSP greenhouses in order to maintain population numbers favorable for field releases. During the past four years, several life stages of the moth have been used in releases in an attempt to establish this insect in the field. Although many thousand first and second instar larvae have been released, as well as dozens of adults and late instar larvae or pre-pupae, we have not been able to observe evidence that this species has become established in field populations of waterhyacinth, or that it has survived the winter. A very probable explanation for this lack of establishment is that all of the release sites have been in field situations where the location was an enclosed finger of water and the open end of the site was boomed off with a rope or plastic device which prohibited the waterhyacinth mat from encroaching into adjacent waters. As a consequence of these booms, the short bulbous plants typical of an expanding mat do not continue to develop and subsequently all plants in these sites grow very tall. Since the short plants are the preferred

host type for moth development, and since the tall plants predominate in our release sites, it is likely that ovipositing females released in these areas search for more suitable egg-laying sites, passing up the abundant non-preferred plants. In addition, we were restricted to releasing the biological control agents within the geographic boundaries of the Delta. In 1987, this restriction was lifted and we were able to attempt to establish Sameodes outside of the Delta.

In 1987, both the waterhyacinth moth and the chevroned waterhyacinth weevil were field released.

Waterhyacinth moth pupae were located in the greenhouse colony by examining waterhyacinth stems for the presence of the hyaline windows characteristic of pupating moths. The cocoons were carefully removed from the petioles, and the pupae were sexed. Several pupae were placed together in clear plastic boxes to await adult emergence. Leaf blades were slit with a razor blade and peeled back to expose a layer of parenchyma cells. They were then placed into the plastic boxes with the adults, so that the females would use them for oviposition sites after mating. Subsequently, these leaf blades which may contain several hundred eggs, were examined to determine when the majority of the eggs had hatched. First or second instars were then transported to the field for release. The small larvae were inserted between the wrapper leaf and central petiole of short bulbous plants to prevent desiccation and to insure that the larvae had an ample supply of food. In addition to early instar moth larvae, several releases of plants from the BCSP greenhouse were made in the field. These waterhyacinth plants were heavily infested with various stages of the moth, and were taken to the field in large plastic bags, each bag containing numerous plants and hundreds of moths.

The mottled waterhyacinth weevils are well established at White's Slough, San Joaquin County. Since the weevils are nocturnal in habit, they can be difficult to collect during the day by simply tearing apart the plants and searching for the adults. However, if the central petiole of the plant is cut or broken off, the plant releases a kairomone which is highly attractive to the adult weevils. By cutting and flagging many petioles the day before collection occurs, numerous weevils were collected by searching the central area of the prepared plants. Adult weevils were transported to the field in pint ice cream containers with a few small waterhyacinth leaves as food. Table 5 indicates the biological agent releases made on waterhyacinth during 1987.

Table 5. Natural enemies released against waterhyacinth during 1987.

County	Site	Date	<u>Sameodes</u> albiguttalis	<u>Neochetina</u> eichhorniae
San Joaquin	Trapper Slough	18 Aug	8 bags	
San Joaquin	Trapper Slough	1 Oct	300 larvae	
Merced	Hopeton Site 1	12 Aug	1780 larvae	
Merced	Hopeton Site 2	17 Aug	1800 larvae	
Merced	Hopeton Site 1	21 Aug	500 larvae	250 adults
Merced	Hopeton Site 3	21 Aug	4 bags	250 adults
Merced	Hopeton Site 5	21 Aug		250 adults
Merced	Hopeton Site 5	10 Sept	10 bags	
Merced	Hopeton Site 6	23 Sept	4 bags; 1500 larvae	
Merced	Hopeton Site 6	16 Oct	4 bags	
Merced	Snelling	9 Oct	300 larvae	

Merced County:

Cooperating with the Merced County Agricultural Commissioner's office, we were able to obtain sites in Merced county; Merced River bypass channels near Hopeton, and portions of the river adjacent to a series of dredge tailings along Highway 59 between Snelling and Merced Falls. Six sites were used and releases totalled 750 Neochetina, and 5880 larval Sameodes as well as 22 bags of plants infested with Sameodes.

Hopeton Site 1:

In August, two releases numbering over 2000 larvae were made here by placing leaves with fewer than 10 larvae on several plants. Larvae from the initial release had burrowed into field plants and heavy feeding damage was evident. In September, adult Sameodes were observed in this location, and in October additional first instar larval damage could be seen. Apparently the moth had completed a generation at this site. In August, 250 adult weevils from White's Slough were released here; this location will be checked for weevil establishment in 1988.

Hopeton Site 2:

In August, 1800 larvae were released at this location. Examination of this site four days after the initial release showed that although the plants appeared tougher than at Site 1, the larvae had entered the field plants and were feeding internally.

Hopeton Site 3:

Plants infested with Sameodes were released at this location, along with 250 adult weevils; both releases were made in August. This site will be examined again next season.

Hopeton Site 5:

In August, 250 adult weevils were released at this location from a bridge. Additionally, bags of plants infested with moth larvae and adults, were released. In September, the site was checked and damage showed that the moth larvae had entered the field plants, and that some pupation had also occurred. In addition, adult moths were seen at this location.

Hopeton Site 6:

In September and in October, bags of infested plants were released here; in September, 1500 larvae were released. First instar larval damage was seen upstream of the first release (about 30 feet upstream). At the actual release site, the larval feeding was so heavy that some plants were beginning to drop out. Future releases need to be widely distributed, as heavy larval feeding can quickly decimate very small plants.

Snelling:

Early instar moth larvae were released here in October. This location is a small tributary parallel to the Merced River. Since the location is far from the highway, only early instars will be released. This site will be checked for establishment next year.

San Joaquin County:

Waterhyacinth weevils were collected from White's Slough and relocated in Merced county.

Releases of moth larvae were made in the Delta at Trapper Slough, where a total of eight bags of plants and 300 larval Sameodes were released. Trapper Slough plants are nutrient-deficient and the plant tissues are very tough. Past releases did not result in moth establishment. In August, infested plants were interspersed into the waterhyacinth mat. In October, late instar larvae were released on plants adjacent to open spaces in the mat. First instar larval damage was noted on a few plants, indicating that the previous release in August had resulted in the production of adult moths that had mated and laid eggs on plants in this location.

PUNCTUREVINE

Although puncturevine, Tribulus terrestris Linnaeus, a member of the caltrop family, occurs throughout most of California, it is most troublesome in the warmer parts of the state in areas with disturbed soil, where its spined fruits can puncture bicycle tires and adversely affect farm workers coming in contact with the weed. This pest is also a seed contaminant and is responsible for injury to grazing animals. Recently, puncturevine acreage has increased in northern California. For several years, redistributions of the seed weevil, Microlepidus lareynii (Jacquelin du Val), and the stem weevil Microlepidus lypriformis (Wollaston) have been made. In 1987, both the stem and seed weevils were released in several locations in the central valley and south coastal valleys (Table 6.). Weevils were also shipped to personnel of the Oregon State Department of Agriculture for subsequent release against infestations in eastern Oregon.

The weevils were collected from known infestations in the Central Valley by placing thin trays under puncturevine plants and tapping these plants to dislodge the weevils. Weevils were then kept in pint containers with some fresh plant material and refrigerated until they were redistributed in new locations. All field release locations will be monitored in 1988 to determine if the weevil populations have become established in the following localities:

Butte County:

Gridley: There were two release sites in Gridley. The first was a ranch where 250 weevils were released. Puncturevine plants were sparse here and no weevils could be detected prior to the release. The second release site was in a walnut orchard, where extremely high populations of very lush growth puncturevine were

present. A few seed weevils were present. Three releases of 250 weevils each were made here. The farm managers are going to spray the strips between the walnuts but will leave the centers alone; the releases were made along these centers.

Napa County:

Veterans Home: The Veteran's Home is off Hwy 29 south of Yountville. The puncturevine plants are growing in a long slender strip along the roadway opposite a grape vineyard. Two releases of 150 weevils each were made at the end of September and the beginning of October. The releases were comprised of more than 90% seed weevils. Examination of a few plants prior to release indicated that seed weevils were present but in very low numbers.

Calistoga: Two releases of 150 weevils each were made on plants growing along a narrow county road. No weevils were found at this site.

Monterey County:

Salinas: The Salinas site is a small reservoir near some Eucalyptus trees, with row crops nearby. Puncturevine plants are growing along all sides of the reservoir. No weevil activity was noted at this location. Three releases of 250 weevils each were made along three sides of the reservoir.

Soledad: A vineyard in Soledad was the site of one release of 250 weevils. A few weevils were found at this site; apparently weevils had been released here many years prior to 1987, and at least a few had persisted or emigrated from

adjacent populations. There are hundreds of acres of grapes planted here, and puncturevine can be found growing along the edges of most of the fields.

San Luis Obispo County:

Ranch 1: This ranch is located in Santa Margarita. Two releases were made, each totalling 125 weevils; one next to permanent pasture acreage where the plants were very dense, and the other in an orchard area near an open garden where the plants were sparse. A few weevils were found near the garden.

Ranch 2: This ranch is in Santa Margarita along the Pozo Road. Two adjacent releases were made here totalling 500 weevils. The releases were made along a road between pasture and a series of barns. Seed weevils were present at this location.

French Camp: These vineyards are in Shandon. One release of 250 weevils was made at the apple orchard near blocks 5 and 7. Moderate puncturevine was present, but no weevils were found. The second release of 250 weevils was made in block 14 opposite a small reservoir, again with a moderate infestation of weeds and no evidence of weevils.

Paso Robles: One release of 250 weevils was made at a ranch in Paso Robles. Puncturevine plants were sparse and no weevils were detected. The release was made adjacent to pasturage.

San Miguel: One release was made by personnel of the San Luis Obispo County Agricultural Commissioner's office, onto a heavy infestation next to two alfalfa fields. Weevils were collected from the Ranch 1 site where previous releases

had been made. The actual number of weevils released is not known. This is a new release locality and additional material will be released at this location in 1988.

Table 6. Natural enemies released against puncturevine during 1987.

County	Location	Date	Number
Napa	Vet's Home	30 Sept	300
Napa	Calistoga	30 Sept	300
Monterey	Salinas	5 Aug	750
Monterey	Soledad	5 Aug	250
Butte	Gridley	28 July	1000
San Luis Obispo	Ranch 1	16 July	250
San Luis Obispo	Ranch 2	4 Aug	500
San Luis Obispo	French Camp	14 July	500
San Luis Obispo	Paso Robles	14 July	250
San Luis Obispo	San Miguel	19 Aug	?