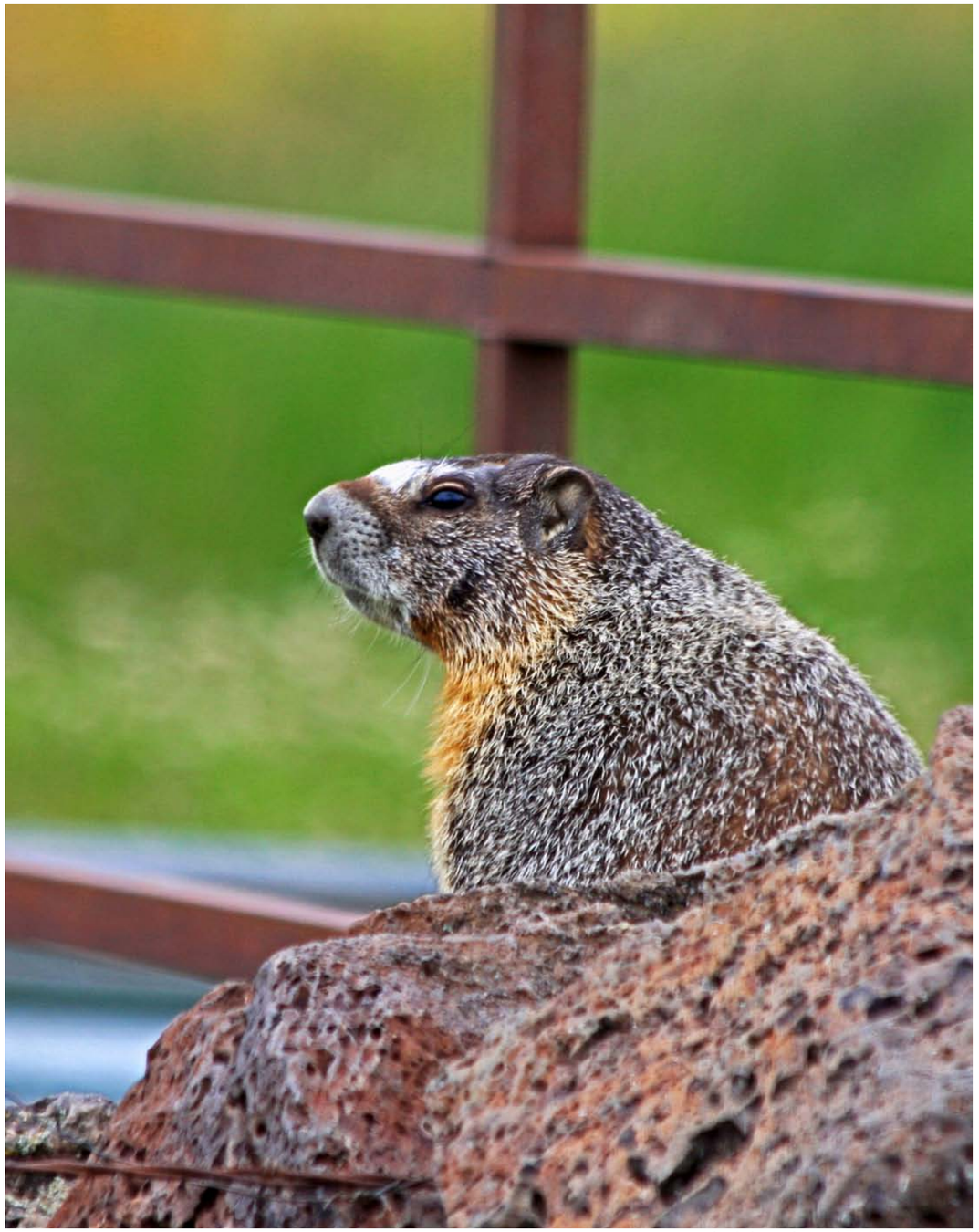
Welcome to

INTEGRATED PEST CONTROL



Marmot in Rocks (Photo by: Ed Williams, CDFA)

INTRODUCTION

The Integrated Pest Control Branch (IPC) is a part of California's pest prevention system with the following overall objective:

Development, implementation and communication of sound public policies on prevention of the damage exotic and harmful plant pests and disease can cause.

The Integrated Pest Control Branch conducts a wide range of pest management and weed eradication projects in cooperation with growers, agricultural commissioners, federal and state agencies, and non-governmental organizations.

BEET CURLY TOP VIRUS CONTROL PROGRAM

Beet curly top virus (BCTV) is an extremely serious plant virus affecting several hundred varieties of ornamental and commercial crops in California. The only known vector of this virus is the sugar beet leafhopper (BLH), *Circulifer tenellus* (Baker).

BCTV is highly destructive to commercially-produced sugar beets, tomatoes, peppers, cucumbers, muskmelons, watermelon, squash, pumpkins, green and dry beans, spinach and varieties of vine seed. Because of the threat to commercial crops, the growers of susceptible crops contribute 100 percent of the funds necessary to control BCTV in California. BCTV also infects backyard gardens upon which many people in California depend to provide fresh table vegetables.

The General Pest Control Strategy Developed by the BCTVCP is to:

- Reduce the potential number of overwintering female BLHs through the application of insecticide on Russian thistle and other weed hosts in the early fall.
- Further reduce surviving gravid overwintering BLH females, prior to egg deposition, once they have concentrated on winter host plants.
- Selectively treat areas of habitat where a spring population of BLHs has developed, preventing migration to crops during late spring and early summer.

Beet Curly Top Virus Control 91
Biological Control Program 96
Hydrilla Eradication Program 101
Weed Management Area Program . 104
Noxious Weeds Program 106
American Recovery and Reinvestment Act 108
Japanese Dodder Program 108
Pink Bollworm Activities 110
Vertebrate Pest Control 116

BEET CURLY TOP VIRUS CONTROL

The Beet Curly Top Virus Control Program (BCTVCP) utilizes intensive surveys to locate and monitor BLH populations throughout the year. Once the populations are located, they are evaluated as to the amount of virus in BLH samples, potential for migration of BLHs to susceptible crops in the area, and feasibility of control versus natural mortality due to parasites, predators or weather trends affecting host plants.

Key Highlights in 2009

- Monitored and selectively suppressed overwintering female BLH populations on winter host plants prior to egg deposition.
- Located, monitored and selectively suppressed the spring hatch of BLHs prior to maturation and migration into susceptible crops.
- Assessed the Program's success by surveying susceptible crops for BCTV.
- Mapped all Russian thistle acreage and suppressed high BLH populations prior to dispersal to overwintering areas.
- Continued to support and solicit research relative to BCTVCP objectives.

Using aircraft and ground spray equipment, a total of 43,555 acres were treated with malathion to control BLH populations during 2009. The acreage totals for 2009 were below the 10-year treatment average of approximately 65,000 acres (Table 1).

Table 1. **(Click on image for larger view.)**

Acres Sprayed by Calendar Year 2000-2009

** Did not have treatment permit during 2008*

	SAN JOAQUIN & COASTAL VALLEYS						IMPERIAL /PALO VERDE VALLEYS (Riverside/Imperial Co.)				
Calendar Year	WINTER		SPRING		FALL		All Seasons		YEARLY TOTALS		TOTAL ACRES SPRAYED
	Air	*Ground*	*Air*	*Ground*	*Air*	*Ground*	*Air*	*Ground*	*Air*	*Ground*	
2009	0	0	34,995	400	7,200	0	0	960	42195	1360	43,555
2008*	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	8,130	800	18,610	240	0	0	26,740	1,040	27,780
2006	3,600	0	32,315	160	18,050	480	0	1,840	53,965	2,480	56,445
2005	0	0	6,921	800	16,100	0	0	4,510	23,021	5,310	28,331
2004	6,600	0	29,820	3,270	10,455	0	0	1,240	46,875	4,510	51,385
2003	6,100	0	68,250	2,270	35,500	0	0	1,220	109,850	3,490	113,340
2002	20,825	0	92,300	4,540	39,950	240	0	0	153,075	4,780	157,855
2001	0	0	57,723	3,764	39,750	1,720	0	1,495	97,473	6,979	104,452
2000	0	0	21,375	3,040	42,753	1,330	0	0	64,128	4,370	68,498
Totals	37,125	0	351,829	19,044	228,368	4,010	0	11,265	617,322	34,319	651,641
AVERAGE	3,713	0	35,183	1,904	22,837	401	0	1,127	61,732	3,432	65,164

WINTER SURVEY

Figure 1. Sparse and Stunted Host Plants in Early March

Below normal rains during 2008 left sparse summer host plant development and low beet leafhopper (BLH) populations throughout the San Joaquin Valley (Figure 1). BLH surveys in January 2009 located little vegetation to perform adequate surveys in most areas. Both rangeland host plants and BLH development were found to be inhibited by the lack of rainfall. While rangeland vegetation was stimulated with more rain, the overwintering adult population remained low and scattered across most of the available host plant vegetation.

Imperial/Riverside Counties: January rains had produced host plant germination throughout the desert, but were found to vary with rainfall patterns. Plantago was found to be abundant across the desert. BLH counts were generally low and scattered across the region.

WINTER TREATMENT

BLH populations were not found in sufficient concentrations throughout the winter treatment area. Therefore, treatments were not performed.

SPRING SURVEY

San Joaquin Valley: Survey activities during February and March found overwintering BLH populations to be lower than average. The lack of rain during the fall and below normal rainfall during the rainy season inhibited the development of host plant populations until January in most areas. Host plant germination was delayed until February in several westside areas in Fresno County. When the first generation hatch occurred, high BLH nymph counts could be found.

Imperial County: As spring progressed and desert vegetation dried, BLH counts on roadside host plants increased. It was determined that very large BLH populations were present in some locations. Endangered species maps were developed for listed species within the greater area prior to roadside survey and ground-rig spot treatments.

Salinas Valley: Dry rangeland habitat was found with little in the way of spring host plant development. BLH counts were found to be low, averaging 1:2 per 10 net sweeps.

BEET CURLY TOP VIRUS CONTROL

SPRING TREATMENT

Aerial Treatment: Treatment activities were performed in Kern County on March 27-28 (Figure 2). Approximately 4,905 acres were treated. All areas selected for treatment in Kern County (9,810 acres) were treated at 50 percent, alternating swath application due to Blunt-nosed leopard lizard habitat.

Figure 2

On March 29 through April 1, treatment activities moved to Kings and Fresno counties. Treated acres:

- Kings County - 9,010 acres
- Fresno County - 21,040 acres

Ground Treatment: Ground-rig spot treatments were performed May 12-15 in Imperial County. There were reports of isolated infection in Santa Cruz County this year; however, no aerial or ground-rig spot treatments were deemed necessary in the Salinas Valley.

FALL SURVEY

Program staff surveyed and mapped BLH host plants on the west side of the San Joaquin Valley for potential fall treatment.

The below normal rainfall greatly reduced the development of summer host plants in historic rangeland. There was an increase in sugar beet leafhopper (BLH) host plant development on cultivated fallow ground in western Fresno County (Figure 3). The increase in host plant vegetation in the Westlands Water District was a result of land fallowed due to lack of water.

Figure 3.

Mowing Russian Thistle
Westside Fresno County

BLH populations never developed on the sparse, water-stressed Russian thistle. High BLH populations were found developing in Fresno County on much of the fallowed ground, which contrasted with mostly stagnant BLH counts in Kings County and most of Kern County.

TREATMENT NOTIFICATION

Following the mapping of Russian thistle and other summer host plants, standard waivers were sent to property owners to obtain permission to perform survey and treatment, if necessary.

FALL TREATMENT

Treatment activities began on October 5 in Kern County. Three fields totaling 750 acres were treated. Treatments in Fresno County were conducted from October 5-7. A total of 7,200 acres were treated. The BLH populations were reduced between 82 percent and 99 percent.

BEET LEAFHOPPER AND HOST PLANT SAMPLING

Throughout most of the growing season, program staff collected 125 plant and leafhopper samples from rangeland habitat and cropland to determine the presence of BCTV strains. The samples were sent to Dr. Robert Gilbertson at the University of California, Davis for analysis.

Both beet mild curly top virus and beet severe curly top virus strains were found. Seventy-nine samples (63 percent) tested positive for BCTV. Beet mild curly top virus was the most prevalent virus found in tomatoes. Among the 79 positive tests, beet severe curly top virus was found 18 times. Half of the samples testing positive for beet severe curly top virus (nine samples) were also found to contain mixed infections of both strains.

Tomato spotted wilt virus (TSWV) was present and complicated the visual assessment of BCTV symptoms in tomato plants. However, the incidence of TSWV infection in tomato was not as prevalent in 2009 as compared to the 2008 growing season.

BIOLOGICAL CONTROL PROGRAM

Key Highlights for the Biological Control Program for 2009 are:

- Foreign exploration efforts discovered three parasites of the olive fly, two of which are approved for release in California. Over 7,700 adults of *Psytallia concolor* (Namibia) and over 4,000 *Psytallia lounsburyi* were released against the olive fly in California in 2009.
- Continued field studies on the biology and management of the Diaprepes root in southern California. Releases of one egg parasitoid species continued in San Diego County and monitoring for establishment was initiated.
- Obtained funding for host testing of a parasitoid of the Asian citrus psyllid. Collection of plants and non-target insects for testing began.
- Discovered four species of *Trichogramma* parasites attacking eggs of the light brown apple moth in California. Three species are native, and the fourth is new to the United States. Egg parasitism was very low during the spring generation of the light brown apple moth. However, over 75 percent of eggs were parasitized during summer.
- Two primary species and six minor species of parasites of the light brown apple moth were discovered in its native region of Australia by University of California, Berkeley and CDFA scientists. The two primary species are in quarantine at the University of California, Berkeley and undergoing host specificity testing.
- The Lygus bug parasite, *Peristenus relictus*, established at release sites in Santa Cruz and Monterey counties. Field studies show that Lygus bug numbers have dropped 70 percent following release of the parasite. Parasitism in 2009 exceeded 60 percent in some locations and parasites were recovered over 18 miles away, suggesting that the parasite has continued to increase in abundance and spread throughout the strawberry production area.
- The stem weevil, *Mecinus janthinus*, released on Dalmatian toadflax was recovered in good numbers at its release site in Kern County. Field samples showed infestation rates between 41 percent and 58 percent.
- A population of the seed weevil, *Microlarinus lareynii* that attacks puncturevine seedpods or "goatheads" was found well established near Susanville in Lassen County. This is the most northern location found for this weevil to date.
- Populations of the two leaf beetles, *Galarucella pusilla* and *G. calmariensis*, released for control of purple loosestrife were found established at a site near Oroville in Butte County, suggesting that these beetles can tolerate the high summer temperatures of California's Central Valley.

BIOLOGICAL CONTROL PROGRAM

The primary objective of the Biological Control Program is to implement self-sustaining biological controls for serious insect and weed pests in California. The Biological Control Program is divided into two working groups: one for insect pests and one for invasive weeds.

INSECT PESTS

Light Brown Apple Moth (LBAM) - The invasive light brown apple moth, Epiphyas postvittana, was first reported in North America in 2007 with populations concentrated in the central coast of California. Efforts to eradicate this exotic pest are underway. Augmentative releases of native Trichogramma species are under consideration to facilitate control efforts by reducing high moth densities.

In 2009, field studies sampled naturally-occurring parasitism of light brown apple moth eggs in Santa Cruz County and at Golden Gate Park in San Francisco County. Results show that parasitism by local *Trichogramma* was very low during the spring generation of the light brown apple moth but significantly increased in summer and fall. Parasitism in San Francisco County was dominated by *T. fasciatum*, with the rare occurrence of *T. platneri* (Figure 4). In Santa Cruz County, parasitism consisted primarily of *T. platneri* in the spring and early summer, followed by predominantly *T. fasciatum* and secondarily *T. platneri* during fall. The recovery of *T. fasciatum* is the first record for this species in the United States.

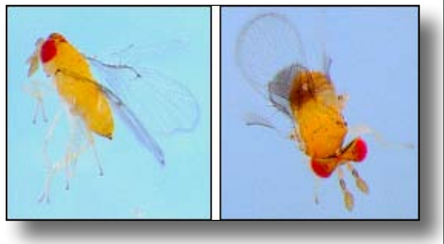


Figure 4.

left: Trichogramma platneri
right: T. fasciatum collected from sentinel eggs

FOREIGN EXPLORATION FOR LIGHT BROWN APPLE MOTH PARASITOIDS

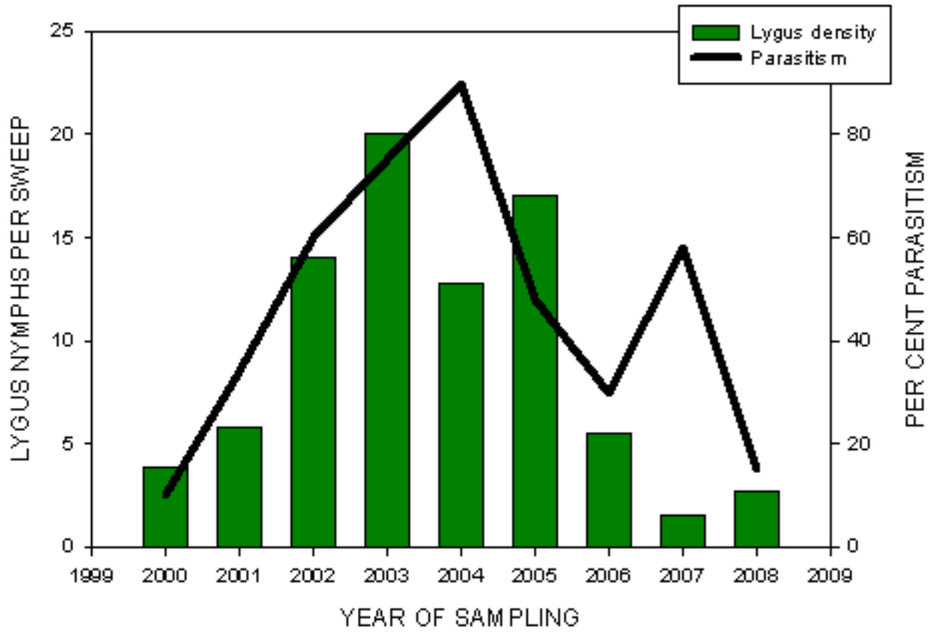
In cooperation with Dr. Nick Mills (University of California, Berkeley), foreign exploration for light brown apple moth parasitoids native to Australia was performed. A series of parasitoid survey efforts in southern Australia in crop and non-crop environments identified two primary species, *Dolichogenidea tasmanica* and *Goniozus jacintae*, and six less common species. Both primary species are now housed in the quarantine facility at the University of California, Berkeley and their host ranges are under evaluation. Host range tests will include four native tortricid species: the orange tortix, the omnivorous leafroller, the oblique banded leafroller and the apple pandemis.

BIOLOGICAL CONTROL PROGRAM

LYGUS BUG

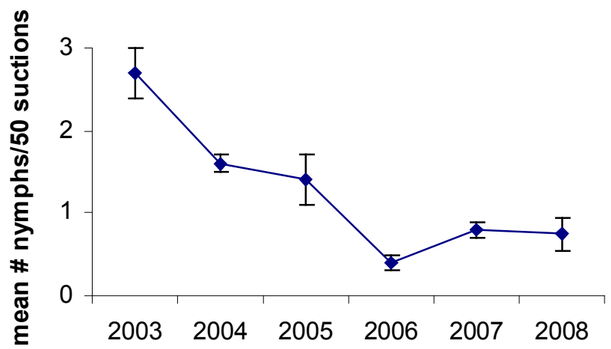
Lygus bug is a serious pest of cotton, strawberries and many other seed crops grown in California. It has developed resistance to traditional insecticides, and the use of newer, more effective products can cause outbreaks of other insect pests. Efforts to introduce two exotic nymphal parasitoids, *Peristenus relictus* and *P. digoneutis*, are underway. Both parasitoid species were produced in cultures at CDFA facilities in Sacramento and released in 1998 (*P. relictus*) and 1999 (*P. digoneutis*) at a research plot near Sacramento. Both were also released at several locations throughout the strawberry production areas along the central California coast from 2002 to 2006. Post-release monitoring at the Sacramento plot showed a substantial reduction in lygus abundance whose peak population densities since 2006 were well below abundance levels observed in 2002-2005 (Figure 5). Lygus abundance in other fields in the Sacramento region showed no declines in abundance.

Figure 5. Nine-year population trend in alfalfa - Sacramento, CA



In Santa Cruz and Monterey counties, only *P. relictus* appears to have established. Efforts in 2009 were directed at monitoring population densities of lygus bug and *P. relictus,* and the spread of the parasitoid from release sites into commercial strawberry production areas. Early results are encouraging. Parasitism at the initial release site in Santa Cruz County exceeded 60 percent in 2009 and the lygus nymphal population remained well below historical levels (Figure 6). Monitoring data from other commercial fields are being collected to determine if this reduction is repeated in other fields ollowing establishment of this parasitoid.

Figure 6. Lygus nymphal densities in organically produced strawberries, Monterey Bay Region, California. The parasite, *Peristenus relictus*, was released in 2002.



WEED PESTS

Dalmation Toadflax: Dalmatian toadflax, *Linaria dalmatica*, is a short-lived perennial from central Europe introduced into the United States around 1874. It is invasive throughout the western United States, including several locations throughout California. The toadflax stem weevil, *Mecinus janthinus*, was released in California in May and June of 2008 in the Hungry Valley State Vehicular Recreation Area (Figure 7). This was the first permitted, intentionally released biological control insect for Dalmation toadflax in California. Releases were made at three sites within the infested area of the park. Three additional nearby sites were selected as 'no-release' comparison sites.

BIOLOGICAL CONTROL PROGRAM

Figure 7. Dalmatian toadflax in bloom at the Hungry Valley State Vehicular Recreation Area where the toadflax stem weevil was released in 2008.

In 2009, all six sites were evaluated for evidence of weevil attack. Results showed that the weevils successfully overwintered at the three release sites, attacking roughly 50 percent of the toadflax stems within three meters of the release locations. The weevils are expected to continue to increase in numbers and spread outward. The 'no-release' control sites were free of any evidence of weevil attack.

Squarrose Knapweed: Several insect biocontrol agents were released against squarrose knapweed in northern California. Insect attack now destroys over 99 percent of the seeds produced each year, effectively preventing production of new (seedling) plants. Current squarrose knapweed infestations are now comprised mainly of older mature plants that continue to age and die. The potential lifespan of squarrose knapweed is not precisely known but our studies show it to be at least eight years, so declines are expected to be slow. Once gone, squarrose knapweed populations will remain low or non-existent due to feeding by seed weevils.

HYDRILLA ERADICATION PROGRAM

HYDRILLA ERADICATION

Highlights for 2009:

- The Program reached a true milestone this year in the Chowchilla River – Eastman Lake Project: we passed seven years with no hydrilla found anywhere in the system (Table 2). With this achievement, the Program will declare the infestation eradicated. Congratulations to the pioneers who undertook this daunting challenge, which began 20 years ago. With hard work and persistence, they overcame all the uncertainties to bring the project to a successful conclusion.

- No hydrilla has been detected in Eastman Lake since 1993. Treatments ceased in the river in 2006. The 2005 and 2006 seasons had high water, enough to germinate any plants in plant-find locations that had been dry, yet no plants emerged.

Table 2. Number of Hydrilla Plants and Tubers Found and Removed from the Chowchilla River, Madera and Mariposa Counties 2000–2009.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Plants	19	5	2	0	0	0	0	0	0	0
Tubers	1,789	23	3	0	0	0	0	0	0	0

- Hydrilla continued to appear in Clear Lake this year, but at a much slower pace than in 2008 (Table 3). The crews found 72 "spots" with hydrilla in 2007 and another 196 spots in 2008, but only 76 spots this year, which was a drop of over 60 percent. In 2008, many of the plants were large, healthy and had reached the surface. This year, no large plants were found, and almost all the finds were small and below the surface. The project added 245 acres that needed treatment in 2007, 325 acres in 2008, and 120 acres this year, for a total of 690 acres needing treatment in 2010. Hydrilla reappeared at Clear Lake after being absent between June 23, 2003 and July 11, 2007. Following the eradication protocol, treatments had ended in the 2006 season. Program biologists anticipated the plant's possible re-appearance and increased the number of boat crews from two in 2006 to three in 2007. The plant's impressive recovery led to increasing the number of crews to four after 2007. The crews this year searched the entire 100+ miles of shoreline 8.8 times during June through November, or once every 2.9 weeks. They also treated nearly every plant within one or two days of finding it.

HYDRILLA ERADICATION PROGRAM

Table 3. Hydrilla and Treatments in Clear Lake, Lake County, 2000 to 2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of hydrilla "finds"	67	41	12	1	0	0	0	72	196	76
Number of management units with finds	31	21	6	1	0	0	0	24	39	24
Fluridone treated acres	1,148	1,335	1,440	1,256	520	137	0	245	573	690
Copper treated acres	117	62	28	5	0	0	0	245	325	120

- Surveyors could find no plants for the fifth year in a row in the infestations at Hesseltine Pond/Bear Creek and Mokelumne Hill (both Calaveras County, found in 1988), and in the infestation in Tulare County (found 1997). They have found no plants for three years in a row in the Redding (Shasta County, found 1994 and 1996) and Nevada County (found 2004 and 2005) infestations.

- The Program lined another 1,500 feet of the most infested section of the irrigation canal in the Yuba County infestation at Oregon House, with the Yuba Agricultural Commissioner's Office and the local Weed Management Area Program, taking the lead on the arrangements. The canal is the headwaters of the infestation. In April 2008, the Program, working with a contractor, had lined about 3,500 feet of the most heavily infested parts of the three-mile infestation.

  Five of the 14 infested ponds in Oregon House had hydrilla in 2009, the same as 2008. In most cases, the infestation was low, although one small pond still produces significant amounts.

  The Program tried several new control options recently. In one pond where there has consistently been hydrilla, the crew stocked sterile triploid grass carp in 2008 and 2009. This is the first time the Program has used carp outside the Imperial Irrigation District. In a pond where there was strong plant regrowth in 2006, staff worked with the United States Department of Agriculture, Agricultural Research Service (USDA-ARS) to test new herbicides: imazamox during 2007-2008 and penoxsulam this year.

- No new infestations of hydrilla were found in California this year, while visiting some 60 lakes, ponds, streams and the Sacramento-San Joaquin River Delta.

- The Program is encountering challenges in the attempt to eradicate a new invader, South American spongeplant. Spongeplant is very similar to water hyacinth, and California would benefit from keeping it out. The first infestation in California was found in 2004 in Shasta County. It responded well to treatment, but in 2006 we discovered large quantities of very small seedlings, indicating that the plant comes back vigorously from seeds. After repeated treatments and hand removal, almost no plants were found in 2009 after a single treatment early in the season. The seed bank appears to last two to three years.

  Unfortunately, since mid 2007, infestations have appeared in at least five other locations, almost all in the San Joaquin Valley. Some infestations are scattered over several miles. The plant population in any one location generally declines dramatically with modest efforts at control, but the multiple finds are straining the Program's ability to keep up.

Background: Hydrilla is a Threat to the Water Resources of the State

Hydrilla is an invasive, submerged, non-native aquatic plant that has been called the world's worst underwater weed. It can: reduce water storage capacity of lakes, ponds and reservoirs; impede water delivery from streams, canals and drains; jam water control structures and choke hydroelectric generators; degrade fish and wildlife habitat; ruin fishing, boating and related tourism (Figure 8); and endanger public health by reducing water flow and producing mosquito breeding habitat. Experience from the infestation in the Imperial Irrigation District indicated that hydrilla can reduce water deliveries from canals as much as 85 percent. Control costs in highly infested states, such as Florida and Texas, are in the tens of millions of dollars per year.

Figure 8. Hydrilla in Clear Lake before treatment began, 1994.

CDFA IS THE LEAD AGENCY FOR THE ERADICATION OF HYDRILLA

Though CDFA is the lead agency, the Hydrilla Eradication Program cooperates closely with local county agricultural commissioners and federal, state, county and city agencies, with Native American tribes and with private individuals and entities. In addition, the Hydrilla Eradication Program received financial and in-kind support in 2009 from the California Department of Boating and Waterways, the California Department of Water Resources, the United States Department of the Interior-Bureau of Reclamation, the United States Army Corps of Engineers-Eastman Lake, the Lake County Department of Agriculture and the Lake County Department of Public Works.

WEED MANAGEMENT AREA PROGRAM

Weed Management Areas (WMA) are dynamic groups of local land managers and public agencies, which have joined together to be more cooperative, strategic and active in battling invasive weeds. WMAs are a unique and crucial infrastructure because:

- They are organized at the local level and can address local issues.
- They foster collaboration between the public and private sector.
- They emphasize education and prevention.
- They bring in matching resources at a ratio of three matching dollars to every state dollar funded.
- They are partners in all statewide weed eradication programs.
- They are partnerships for a better environment.
- They are meant to complement, not supplement, the California Department of Food and Agriculture's (CDFA) core weed management programs.

2009 FISCAL YEAR WEED MANAGEMENT AREA (WMA) STATE FUNDING PROJECT

CDFA received $1.5 million in state general funds for weed eradication projects to be distributed to weed management areas. After consulting with various stakeholder groups and the Weed and Vertebrate Committee of California Agricultural Commissioners and Sealers Association (CACASA), the CDFA WMA Program issued a request for proposals in March 2009.

Ten percent of funds are set aside for CDFA program administration and research. After allocations toward administrative costs and research, the balance is allocated toward baseline funding for each county partner in a WMA. A consensus of the WMA Oversight Committee was reached to provide funds to all 58 counties, as opposed to 45 WMA groups, since many WMA groups have more than one county. Baseline funding was not competitive, but rather an equal distribution to each county partner within a WMA. All WMA base funding work plans can be viewed on the CDFA WMA website.

By legislation, a portion of the funds are allocated for competitive grants. A request for proposals was developed and all WMA groups were eligible to submit proposals for competitive funds. A WMA Advisory Committee ranked the proposals according to achievement of high priority objectives such as permanent eradication and protection of high value assets. The WMA Advisory Committee, as required by the agricultural code, included industry, conservation, scientific and public group representatives. Proposals were required to show a minimum 50:50 match. Seven out of a total of 31 submitted supplemental proposals were selected for funding.

For the past several years, the United States Forest Service (USFS) has funded CDFA to manage a grant program for the prevention, detection and eradication of noxious and invasive weed populations on non-federal public and private lands near forested lands throughout California. The USFS Grant is to prevent the movement of noxious and invasive weeds onto federal forested lands. CDFA has managed the Program via a competitive grant program to weed management areas. Funded projects have included survey and detection for noxious and invasive weed populations, control and eradication activities, and public outreach and education to stop or slow the spread of noxious and invasive weed seed and plant parts.

Many of the USFS lands throughout California are relatively weed-free. However, invasive weeds can move onto USFS lands from adjacent and nearby non-federal public land, private land and tribal land. Pathways of infestation include public and private roads, logging trails, firebreaks, streams, rivers and wind. Weed seed and plant parts can be transported onto forested lands by vehicles (cars, pickup trucks, logging trucks, road maintenance and construction traffic), people (shoes and clothing, hunting, fishing, camping and logging equipment), nearby fire "burned" areas, roadsides and utility rights-of-way, pastures and rangelands, agricultural lands and abandoned wild lands.

Several WMA groups have been funded over the years addressing the following noxious weeds: meadow knapweed, spotted knapweed, purple loosestrife, slender false-brome, leafy spurge, Dalmatian toadflax, rush skeletonweed, perennial pepperweed, musk thistle, Scotch thistle, Iberian starthistle, yellow starthistle, and arundo.

In summary, this partnership between the USFS and the CDFA has proven to be an effective program to slow or prevent the movement of noxious and invasive weeds onto federal forested lands.

NOXIOUS WEEDS PROGRAM

The Noxious Weed Eradication Program's accomplishments in 2009 were:

- 170 distinct A-rated weed infestations were treated and evaluated by program staff.
- Over 11,000 miles of state, county and forest service roads were surveyed for A-rated weeds.
- Program staff gave 27 presentations on noxious weed biology, identification and management techniques. Over 400 public, private and non-governmental attendees participated in these outreach and education events.
- The Program received a federal stimulus American Reinvestment and Recovery Act (ARRA) grant for $7.5 million from the United States Forest Service for the prevention, early detection and eradication of noxious and invasive plants.

The objective of the Noxious Weeds Program is the early detection, containment and eradication of A-rated noxious weeds (Figure 9). A-rated noxious weeds are those of potential great economic or environmental importance, of current limited distribution in the State and for which eradication efforts will likely be successful. Noxious Weed Eradication projects are a cooperative effort between the California Department of Food and Agriculture (CDFA), county agricultural commissioners, United States Department of Agriculture (USDA), United States Forest Service (USFS), and Weed Management Areas (WMAs) across the State.

To date, the Noxious Weeds Program has eradicated 13 weeds from the State. These are whitestem distaff thistle, dudaim melon, giant dodder, serrate spurge, Russian salt tree, blueweed, tanglehead, creeping mesquite, meadow sage, heartleaf nightshade, Austrian peaweed, wild marigold and Syrian beancaper. Weeds approaching eradication at the statewide level include camelthorn, golden thistle, Illyrian thistle, perennial sowthistle, Taurian thistle and smooth groundcherry.

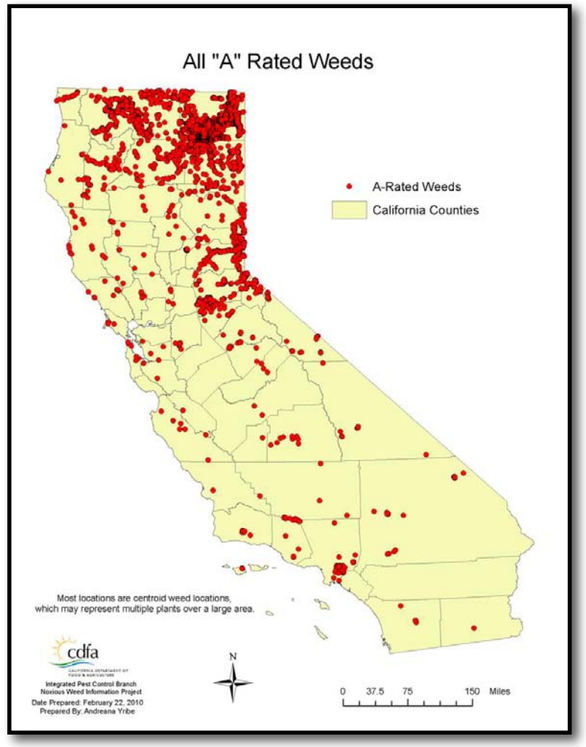
Figure 9. California Conservation Corp, Iberian Star thistle control *(Centaurea iberica)* near Blanchard, CA typical rangeland improvement management of "A" rated weeds.

The California Food and Agricultural Code, Section 403, which states, "The Department shall prevent the introduction and spread of noxious weeds", authorizes the Noxious Weeds Program. The term "noxious weed" is defined in Code Section 5004 as "any species of plant which is, or is liable to be, detrimental or destructive and difficult to control or eradicate."

In addition, the state of California incorporates the federal noxious weeds as state noxious weeds by regulation (CCR, Section 3161).

The statewide distribution of current A-rated noxious weed infestations can be seen on the following map (Figure 10). Note that a disproportionate number of the A-rated noxious weed infestations in California are found in the four most northeastern counties (Lassen, Modoc, Shasta and Siskiyou). This distribution results partially from the large amount of open rangeland in these counties and the related movement of cattle and sheep from out-of-state to these grazing lands. It also results from the movement of weed seeds and viable plant material on vehicles and equipment from other states into these areas.

Figure 10. All "A" Rated Weeds



Click on image to download map.

ARRA / JAPANESE DODDER PROGRAM

AMERICAN RECOVERY AND REINVESTMENT ACT (ARRA)

The Integrated Pest Control Branch (IPC) has had a working relationship with the United States Forest Service (USFS) for the last several years and will continue to receive grants in the near term for invasive plant work. In March 2009, the Branch was notified that the possibility of receiving additional dollars for invasive plant work via the federal stimulus plan was a possibility. In fall 2009, IPC received award letters from the USFS, stating that two grants totaling $7,497,000 were forthcoming with $331,000 designated by the USFS for the distressed counties of Los Angeles and Siskiyou. The balance of the grant will be distributed to CDFA partners for the prevention, early detection and eradication of noxious and invasive plants on non-federal public and private lands near forested lands. The majority of the monies issued from the grant to CDFA sub-recipient partners is for work estimated to begin in January 2010 and ending in December 2011. To date, approximately 41 sub-recipients have either applied or received agreements or contracts for this work.

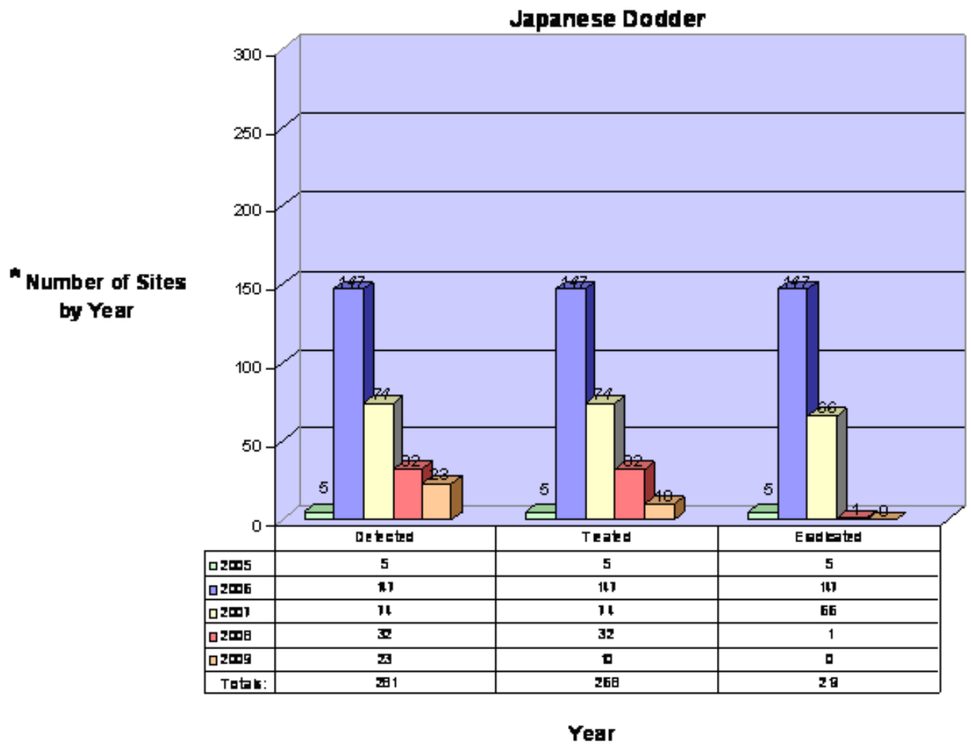
JAPANESE DODDER PROGRAM

In 2009, the Japanese dodder, *Cuscuta japonica* (C. japonica), survey and eradication program goals were to detect and eradicate infestations (Figure 11) of Japanese dodder in California.

As in the previous year, no new infested counties were added and, after reaching a peak in 2006, the number of infestations continues to fall (Table 4). The Program will continue the utilization of available demographic information to locate probable sites of Japanese dodder. Each of the 58 counties in the State is placed into one of three tiers based on the probability of detecting Japanese dodder. The tiers are as follows; Tier I, with high probability (due to a large ethnic population and conducive climate); Tier II, with moderate probability (adjacent to infested counties); and Tier III, with low probability (environment unsuitable for establishment).

The Program is a cooperative effort among the Department, county agricultural commissioners and the USDA. Currently, there are 271 active sites in nine counties, and when detected, all sites are eradicated by removal of infested plant material that is transported to an approved landfill and deep buried. Each treated site is required to be monitored post-treatment to look for any resurgence of the infestation. In 2009, the CDFA Exotic Pest Hotline continued to receive inquiries about Japanese dodder and led to the detection of four sites in two counties.

Table 4. Includes eradicated sites in the counties of Los Angeles, San Joaquin, Shasta, Sutter and Yolo. (**Click on image for larger view.**)



	Detected	Treated	Eradicated
2005	5	5	5
2006	147	147	147
2007	74	74	66
2008	32	32	1
2009	23	10	0
Totals:	281	268	219

Figure 11.

JAPANESE DODDER / PINK BOLLWORM

HISTORY OF JAPANESE DODDER

Japanese dodder is a noxious, annual parasitic plant native to the eastern Asian seaboard and is within a group of dodders frequently referred to as "Giant dodder" (*C. reflexa* and *C. japonica*). First introduced to the United States in Texas in 1941, other infestations were found in Florida in 1943 and in South Carolina on the campus of Clemson University in 1971. Japanese dodder is a leafless parasitic plant that uses specialized temporary root structures called haustoria to obtain water and nutrients from a host plant. Once *C. japonica* seedlings locate a suitable host, they die and the haustoria colonize the host stem and begin to draw water and nutrients from the host.

The Japanese Dodder Eradication Program developed a protocol to provide guidance and establish standards for dealing with infestations.

The six components of the protocol are:

- Detection
- Delimitation
- Eradication
- Post-treatment Monitoring
- Outreach and Education
- Regulatory

The detection component of the protocol (see inset) has several focal points to detect Japanese dodder as follows: the use of citrus greening and tristeza survey personnel to locate incipient infestations; a systematic visual survey of all square mile grids known to contain Japanese dodder; and the use of exotic pest trappers during normal trap servicing. When an infestation is located, 200-meter delimitations and one-mile surveys are conducted to determine boundaries. Treatment, post-treatment monitoring and eradication occur according to timeframes set forth in the protocol. Outreach and education activities in 2009 were limited to the distribution of printed materials, and occasional community meetings were held in the infested areas of the State.

STATE SURVEY

In 2009, state personnel surveyed over 400,000 urban and rural residential properties in the 13 non-contracted counties that are likely, based on demographic information, to have Japanese dodder. This survey resulted in no detections of Japanese dodder.

PINK BOLLWORM ACTIVITIES

The boll weevil, *Anthonomus grandis* Boheman, and the pink bollworm, *Pectinophora gossypiella* Saunders, are probably the two most important cotton pests in the United States. These serious economic pests are the subject of various area-wide control programs by federal, state, local and commercial organizations throughout areas of the United States Cotton Belt. A pink bollworm cooperative eradication program has been started in defined cotton growing regions in Arizona, California, New Mexico, Texas and Mexico.

The CDFA Pink Bollworm (PBW) Program prevents the establishment and spread of this devastating pest and follows the basic guidelines and protocols established under the USDA Area-Wide PBW Eradication Program. The technology used to eradicate pink bollworm has five primary components: 1) extensive survey; 2) transgenic *Bacillus thuringiensis* cotton; 3) pheromone application for mating disruption; 4) sterile PBW moth releases; and, 5) crop cultural control requirements. Program technologies are applied on an area-wide basis within each area.

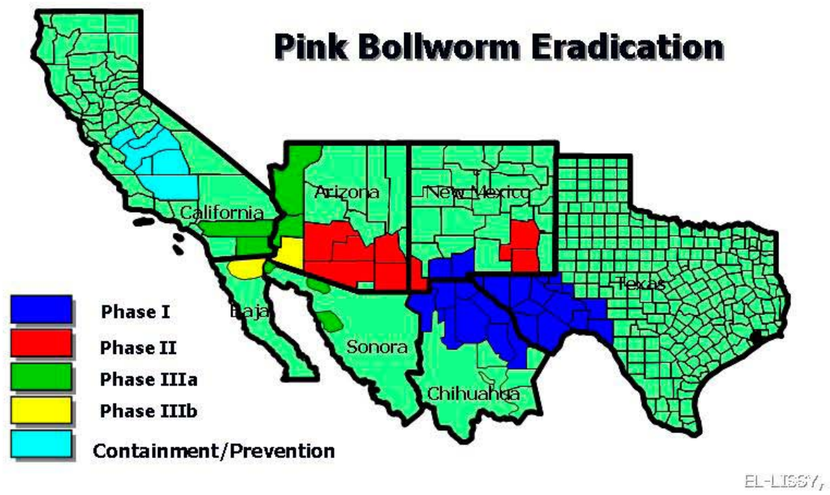


Figure 12. Pink Bollworm Eradication

The program activities of detection and control are coordinated with the USDA and other cooperating state agencies. The CDFA PBW Program uses a risk-based management approach for program detection and control objectives within the San Joaquin Valley (SJV) containment / prevention area (Figure 12).

The USDA pays the costs of sterile production/release activities within California's area-wide PBW Eradication Program. All other program costs of the CDFA PBW Program are industry funded. The assessment fee remains at $2.00 per bale.

PINK BOLLWORM ERADICATION

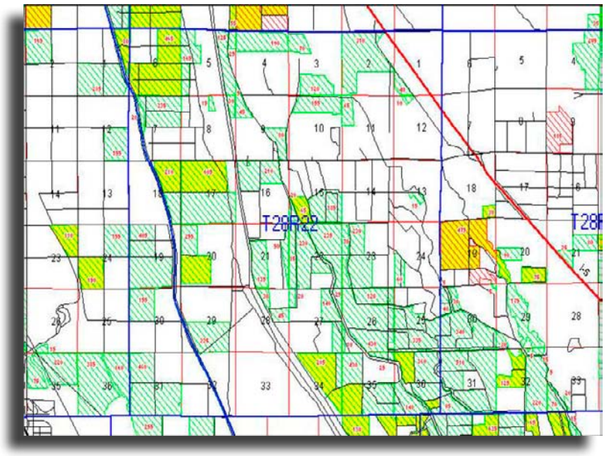
TRAPPING

All cotton-field mapping throughout the State was digitized into computers. These digitally computer generated maps, depicting individual cotton fields, were utilized in trapping, boll survey, sterile release and plowdown monitoring (Figure 13).

A grand total of 190,065 acres of cotton was mapped in California during 2009. Southern California cotton acreage totaled 6,395 acres. Sacramento Valley had a total of 2,390 acres.

PBW Program personnel mapped 181,280 acres of cotton in six counties of the SJV. Pima cotton plantings in SJV for 2009 totaled 118,975 acres (approximately 66 percent).

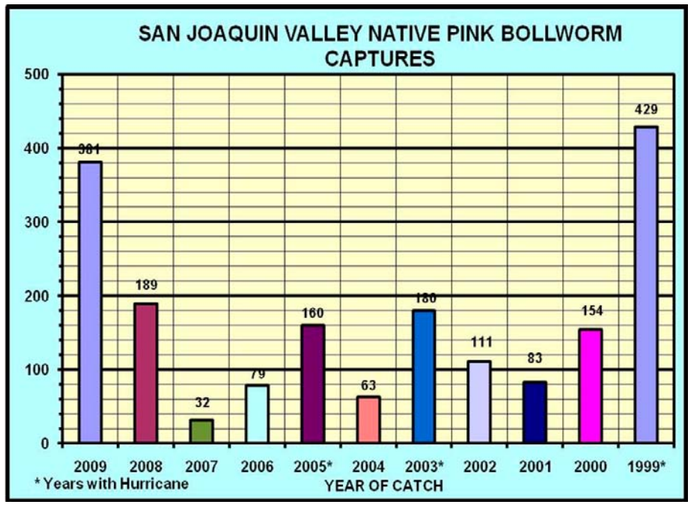
Figure 13. Cotton Map with Pima Varieties in Yellow, Upland in Green



IDENTIFICATION

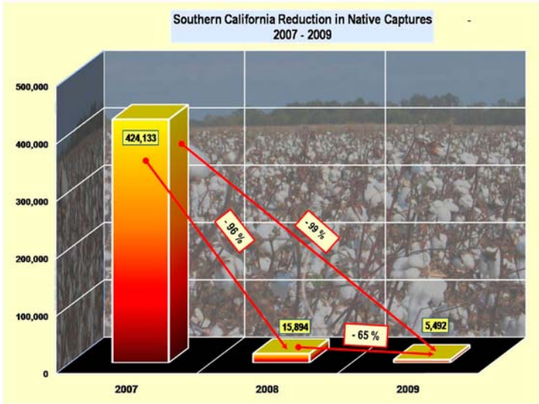
For the San Joaquin Valley (SJV), the lab examined 4,862 traps containing suspect moths submitted by trappers. A total of 73,243 sterile moths and 381 native moths were identified in the SJV traps in 2009 (Figure 14).

Figure 14.



In southern California, pink bollworm (PBW) populations were significantly reduced from the previous year. There was a slight spike in native captures from mid-August into September due to migration from the adjoining area of northern Mexico. Overall, there was a significant decline in natives trapped compared to the pre-area-wide PBW Eradication Program 2007 capture levels due to program control activities (Figure 15). Since 2007 there has been a 98.9 percent drop in PBW moths per trap per week.

Figure 15.



PINK BOLLWORM ERADICATION

STERILE INSECT RELEASE

The average daily release rate for the San Joaquin Valley (SJV) was 1.5 million sterile moths per day when sterile release began on May 6 (Figure 16). The release rate was increased to two million per day on August 7 and remained at two million sterile moths released per day until releases concluded October 3, 2009. Approximately 220,787,334 sterile moths were released in the SJV.

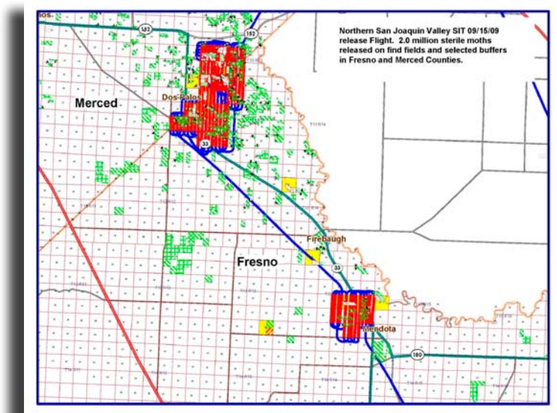


Figure 16

Southern California cotton growing regions were added to the USDA Pink Bollworm (PBW) Area-Wide Eradication Program in 2007. The strategy for this program includes insect monitoring, *Bacillus thuringiensis* (Bt) cotton plantings, sterile insect release and pheromone treatments in non-Bt cotton.

Mass aerial dispersal of sterile PBW moths was performed on cotton plantings in Imperial, Riverside and San Bernardino counties. Approximately 40.8 million sterile moths were released during the cotton-growing season in southern California as a component of the PBW Area-Wide Eradication Program.

PHEROMONE APPLICATIONS

A control method used by the PBW Program is pheromone mating disruption (Figure 17). This technique can induce mating disruption, interfering with reproduction during that period. Three fields totaling 60 acres were treated at the rate of 200 ropes per acre, for a total 12,000 pheromone ropes. No native moths were trapped in these fields in 2009.

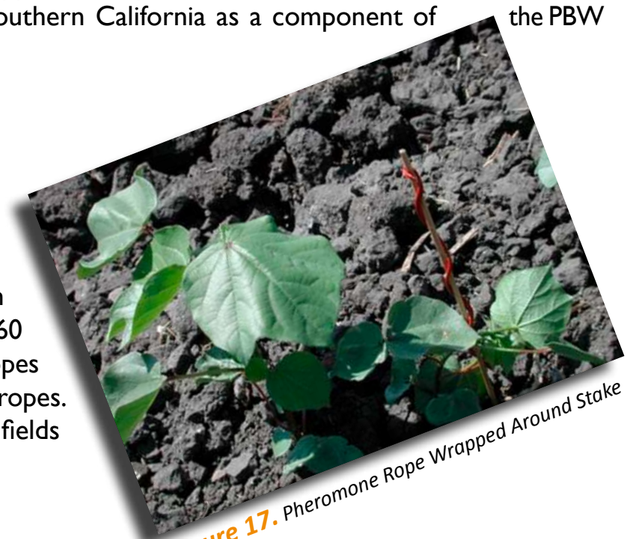


Figure 17. Pheromone Rope Wrapped Around Stake

Bt RESISTANCE MONITORING

Cooperating with the USDA, the Arizona Cotton Research and Protection Council and the University of Arizona, Pink Bollworm (PBW) Program staff conducted trapping and boll survey designed to evaluate PBW resistance to *Bacillus thuringiensis* (Bt) cotton. To date, no resistance has been observed.

COTTON PLOWDOWN REGULATIONS

A reduced tillage permit was issued by CDFA to the PBW regulated districts in the San Joaquin Valley (SJV), and a minimum tillage permit was issued to regulated districts in Imperial and Riverside counties. These permits had several key requirements, including: grower notification to the local county agricultural commissioner; post harvest cotton plant shredding and tillage sufficient to prevent plant regrowth; regulatory inspection of cotton fields; and, for the SJV only, substantial prohibited or restricted areas based on PBW native finds. The most significant change was not requiring that roots, plant stubs, shredding debris and trash remaining from harvesting or clean–up operations be mixed with surface soil.

COTTON BOLL WEEVIL

Since November 19, 1990, no boll weevils, *Anthonomus grandis*, have been trapped in California (Figure 18). The declaration of eradication of boll weevil was issued December 1993. Program efforts continue to maintain boll weevil-free status. Traps are deployed in southern California cotton growing areas to monitor boll weevil activity. No cotton boll weevils were detected.

Figure 18.

Photo by: Alton N. Sparks, Jr., Univ. of Georgia, Bugwood.org

VERTEBRATE PEST CONTROL

THE KEY ACCOMPLISHMENTS FOR 2009 INCLUDE:

- Public Outreach and Education Seminars: Wildlife Damage Management.
- County Bait Manufacturing Quality Assurance/Quality Control Program.
- Vertebrate Pest Control Handbook Development and Publication.
- Specialty Crop Block Grant Award.
- Vertebrate Pest Control Research Advisory Committee (VPCRAC). The primary objectives of the Vertebrate Pest Control Research Program are to maintain the CDFA's field-use rodenticide registrations, provide public education on wildlife damage management and to administer the Vertebrate Pest Control Research Program. The agricultural community and other stakeholders utilize the CDFA's rodenticides in order to prevent and control vertebrate pest damage to agricultural commodities, agricultural infrastructure, water control and conveyance structures, and to protect public health and safety.

The Vertebrate Pest Control Research Program funds research studies to investigate experimental application strategies to improve rodenticide efficacy, non-target hazard studies to reduce the potential hazard of secondary poisoning to non-target species, and produce chemistry and residue data to support the expanded use of rodenticides on crops. Since 1991, the Vertebrate Pest Control Research Program has funded 120 research projects totaling over $8.7 million.

VERTEBRATE PEST CONTROL

PUBLIC OUTREACH AND EDUCATION SEMINARS

Wildlife Damage Management: In 2009, Vertebrate Pest Control Research Program staff provided public outreach and education seminars to the University of California Cooperative Extension Master Gardener Program, the Pesticide Applicators Professional Association, the United States Fish and Wildlife Services, the United States Department of Agriculture, the California Agricultural Commissioners and Sealers Association, and the Department of Pesticide Regulation.

- Eleven education seminars were presented to the public.
- Approximately 1,500 people attended the education seminars.
- Education seminars were presented on Laws and Regulations, Bird Control, Predator Management, Small Mammal Control, Invasive Species Management and current research projects.

COUNTY BAIT MANUFACTURING QUALITY ASSURANCE / QUALITY CONTROL SAMPLING PROJECT

Compliance agreements are in effect between the California Department of Food and Agriculture (CDFA) and eight county agricultural commissioners that formulate rodenticide baits on behalf of CDFA. The compliance agreements specify conditions of manufacture and are part of an overall Quality Assurance/Quality Control Program CDFA has implemented. As part of this program, the Vertebrate Pest Control Research Program staff conducted a comprehensive bait sampling project. Samples of the formulated baits were obtained at each manufacturing county and analyzed at the CDFA chemistry laboratory. The purpose of the sampling project is to ensure that all CDFA–registered rodenticides formulated by the county agricultural commissioners are produced in compliance with the 40 CFR, subpart 158.175, Certified Limits. The sampling project will provide assistance and resources to the formulating county agricultural commissioners to ensure that the formulating county agricultural commissioners can consistently produce material that is in compliance with the United States Environmental Protection Agency certified confidential statement of formula and certified limits.

VERTEBRATE PEST CONTROL HANDBOOK DEVELOPMENT AND PUBLICATION

The *Vertebrate Pest Control Handbook Fourth Edition* (J.P. Clark 1994) has been used as a resource on vertebrate pest control throughout the State and nation, and has been considered the standard for vertebrate pest control information in California. The handbook, as originally written, was the guidebook for the California agricultural commissioners in their efforts to deal with important

VERTEBRATE PEST CONTROL

vertebrate pests in agriculture and public health. Although the handbook has been an important resource in the past, several portions of the handbook were outdated, such as the laws and regulations, vertebrate pest control products, information on diseases related to wildlife and humans, and recent research on wildlife damage management. In 2006, the Vertebrate Pest Control Research Advisory Committee (VPCRAC) funded the development of a revised handbook to provide a relevant, updated resource for California's pest problems. Revisions were made by the CDFA, the University of California, and the California Department of Health Services. The new version is complete and available on the VPCRAC website, www.vpcrac.org. Accurate and up-to-date information is now available to agricultural producers and other interested parties.

SPECIALTY CROP BLOCK GRANT AWARD

Vertebrate Pest Control Research Program staff applied for and was awarded a competitive Specialty Crop Block Grant (SCBG) for the purpose of developing an integrated pest management program for vole control in artichokes. The artichoke industry in California has suffered from severe small mammal damage for several years. Growers are experiencing substantial financial losses due to crop damage attributed to voles, and unfortunately, have a very limited vole management program. For the past twenty years, artichoke growers have used chlorophacinone-treated artichoke bracts to control vole populations. This was an acceptable treatment program until about eight years ago, when artichoke growers began to notice an uncharacteristic increase in vole populations. Studies were conducted to determine if voles were resistant to chlorophacinone, and 50 percent of the Castroville voles tested were determined to be chlorophacinone resistant. The SCBG will allow CDFA, in collaboration with the University of California, Kearney Agricultural Center, to conduct field studies to determine the efficacy of rodenticide treatments, cultural practices and trapping to develop a comprehensive integrated pest management program for vole control in artichokes.

VERTEBRATE PEST CONTROL RESEARCH ADVISORY COMMITTEE

The Vertebrate Pest Control Research Advisory Committee held two meetings in 2009. The first meeting was held on April 22 in Napa County and the second on October 7 in Ventura County.

The following research proposals were recommended for funding by the Committee, approved by the Secretary of CDFA, and initiated in 2009:

- "Amended Scope – Vertebrate Pest Control Certification, Education and Outreach," University of California, Cooperative Extension, San Diego County
- "Reregistration of CDFA Baits for Control of Norway and Roof Rats in Agricultural Fields," University of California, Integrated Pest Management, Kearney Agricultural Center
- "Development and Evaluation of the VPCRAC Website for Vertebrate Pest Research Information," University of California, Cooperative Extension, San Diego County
- "Development of an Integrated Pest Management Program for Vole Control in Artichokes," University of California, Integrated Pest Management, Kearney Agricultural Center
- "Food Safety and Rodent Control in Leafy Green Crops – Amended Per VPCRAC Request," University of California, Cooperative Extension, San Diego County
- "Using Liver Microsomes to Screen Anticoagulant/Inhibitior Formulations for Meadow Vole Control," USDA, APHIS, Wildlife Services, National Wildlife Research Center