

**FINAL REPORT STUDY NO. 01-0703**

**STUDY TITLE:**

Chlorophacinone Efficacy Feeding Studies Using 0.01% Chlorophacinone Artichoke  
Bract for Controlling California Meadow Voles (*Microtus californicus*)

**FIFRA GUIDELINE:**

96-12 Rodenticides on Farm and Rangelands  
950.2500 Field Testing for Terrestrial Wildlife

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**TEST DATES:**

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Experimental Start: April 8, 2002  
Experimental Termination: October 2002  
Study Completion: November 30, 2002

**SPONSOR:**

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## STATEMENT OF NO DATA CONFIDENTIALITY CLAIMS

No claim of confidentiality is made for any information contained in this study on the basis of its falling within the scope of FIFRA 10 (d) 1 (A), (B) or (C).





Duane Schnabel

Date

Senior Agricultural Biologist

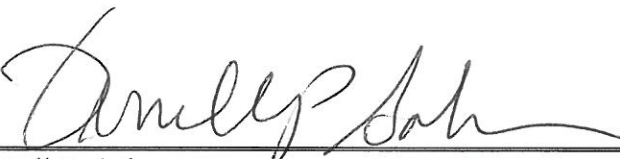
Integrated Pest Control

California Department of Food and Agriculture

## GOOD LABORATORY PRACTICE STATEMENT


The study contained herein, 01-0703, was not conducted in accordance with the requirements of Title 40, Code of Federal Regulations, Part 160, Good Laboratory Practice Standards. The primary difference was that a Quality Assurance Officer was not on site during the study. However, data and records were collected and will be kept in accordance with procedures consistent with Good Laboratory Practice studies. The following records will be kept: 1) general laboratory procedures and conditions, 2) data collected for bait efficacy, 3) personnel training and qualification records.

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All raw data, the original final report, all written communications between the performing laboratory and the sponsor regarding this project, and all original SOPs are kept at the facilities of the Department of Wildlife, Fish and Conservation Biology at the University of California in Davis, California.

We appreciate the help of Sea Mist Farms and associated artichoke growers in Monterey County, California. Special thanks to Dale Huss for access to Castroville artichoke fields where we were able to set up study sites, and for his willingness to manage these areas to accommodate our field studies. We thank Adrian Zendejas for providing us with the Castroville voles needed to conduct our cage and pen efficacy feeding trials, and for providing us with Sea Mist Farms workers to bait specified areas in accordance with our study. We also thank David Bryson from Liphatech for supplying us with 2% chlorophacinone concentrate which was needed to make the artichoke bract bait used in the feeding trials, and Jon Usher from Kleen Globe for making sure that we had everything that we needed to carry out our studies.

### **Introduction**

Artichoke growers in Castroville are currently using a chlorophacinone rodenticide (0.01% Rozol oil artichoke bract bait), to control their primary agricultural pest, the California meadow vole (*Microtus californicus*). In late 2002 the Rozol oil manufacturer will drop the Federal registration, creating a need for a replacement material. The suggested replacement is a mineral oil-chlorophacinone powder mixture that forms a 0.28% chlorophacinone suspension. The chlorophacinone suspension is blended with a specified mass of artichoke bracts to make 0.01% finished chlorophacinone artichoke bract bait.

In order to test the new solution as an effective replacement for Rozol oil (0.28%), we performed a series of bract bait feeding trials where efficacy of the product was measured. These trials consisted of three different types; cage trials conducted in the laboratory under controlled conditions, outdoor pen trials, and trials in commercial artichoke fields near Castroville, California.

### **Objectives**

The primary objective of this study is to determine the efficacy of the new chlorophacinone formulation in controlling the California meadow vole in artichokes. Chlorophacinone efficacy feeding trial data for the new 0.28% suspension formulation will support product registration and help determine if the new formulation is an effective replacement for Rozol oil.

Our secondary objective is to compare baiting strategies (treatment frequency) to determine which baiting regime produces the highest mortality.

This study was conducted under Animal Use Protocol # 9786 approved by the University of California Animal Use and Care Committee, 10/11/2001.

## **Cage Trials**

### **April 2002**

#### **Methods and Materials:**

All animals were individually housed in stainless steel cages designed for small rodents. The test room had a controlled environment with constant 12:12 light:dark cycle. Room temperature was maintained at 70-75<sup>0</sup> F. Animals were provided laboratory chow, fresh artichoke bracts and water ad lib. All animals were acclimated to laboratory and cage conditions for a minimum of 7 days prior to beginning the feeding trials. On treatment days, normal laboratory chow and water were available at all times. The predetermined number of 0.01% chlorophacinone treated artichoke bracts was placed in each cage. These were removed 24 hours later. If re-treatment was specified, fresh treated artichoke bracts were provided for the 24 hour period. All animals were observed for 21 days after initiation of the feeding trial for signs of anticoagulant toxicosis.

#### **Treatment Groups**

Because of limited laboratory space, animals were tested in groups of 20 with no more than 3 groups being tested at any one time.

##### **April 8, 2002**

Group 1a- 20 voles from Castroville that were given 0.01% Chlorophacinone bracts on day 1 of the trial.

Group 2a- 20 voles from Castroville that were given 0.01% Chlorophacinone bracts on days 1 and 5.

Group 3a- 20 voles from Castroville that were given 0.01% Chlorophacinone bracts on days 1 thru 5.

Group 4a (control group)-8 voles from Castroville that were given mineral oil coated bracts on day 1 of the trial.

##### **April 30, 2002**

Group 1b- 20 voles from Castroville that were given 0.01% Chlorophacinone bracts on day 1 of the trial.

Group 2b- 20 voles from Castroville that were given 0.01% Chlorophacinone bracts on days 1 and 5.

Group 3b-20 voles from Castroville that were given 0.01% Chlorophacinone bracts on days 1 thru 5.



## **Preparation of Bracts**

### ***0.28% chlorophacinone/mineral oil suspension***

39.7g of 2% Chlorophacinone powder

243.8g mineral oil

Suspension was made by adding chlorophacinone powder to the mineral oil and mixing until a uniform suspension was obtained (approximately 5-10 minutes with hand mixing).

### ***0.01% Chlorophacinone artichoke treated bracts***

47.76g 0.28% chlorophacinone/mineral oil suspension

1300g fresh individual artichoke bracts.

Target ratio of oil to bracts = .03674g oil/g bracts

Bracts were placed in a large mixing bowl and chlorophacinone oil suspension was dripped over bracts. Chlorophacinone oil was then mixed with bracts for five minutes by hand.

### ***Mineral oil coated bracts***

9.53g mineral oil/259.4g bracts

Bracts were placed in a mixing bowl and mineral oil was dripped over bracts. The mineral oil was then mixed with bracts for five minutes by hand.

## **Treatment Procedure**

Group 1a and 1b- All animals were weighed prior to the treatment day. Fourteen Chlorophacinone oil bracts were placed in each cage on day 1 and then taken out on the 2<sup>nd</sup> day of the trial. The animals were then fed their normal lab diet of lab chow, artichoke bracts and water ad lib for the remaining 20 days of the study and observed for signs of anticoagulant toxicosis.

Group 2a and 2b- All animals were weighed prior to the first treatment day. Fourteen Chlorophacinone oil bracts were placed in each cage on day 1 and then taken out on the 2<sup>nd</sup> day of the trial. Following the first treatment, the animals were then fed their regular diet of lab chow, artichoke bracts and water ad lib. On the 5<sup>th</sup> day of the trial, the animals were given the 2<sup>nd</sup> treatment of 14 Chlorophacinone oil bracts which were removed 24 hours later. For the remaining 16 days of the study the animals were fed their regular lab chow and artichoke bracts and given water ad lib. During the entire test, animals were observed for any signs of anticoagulant toxicosis.

Group 3a and 3b- All animals were weighed prior to the first treatment day. On day 1 of the trial 5 Chlorophacinone oil bracts were placed in each cage. On days 2,3,4 and 5 the same procedure was followed. For the remaining 16 days of the study the animals were

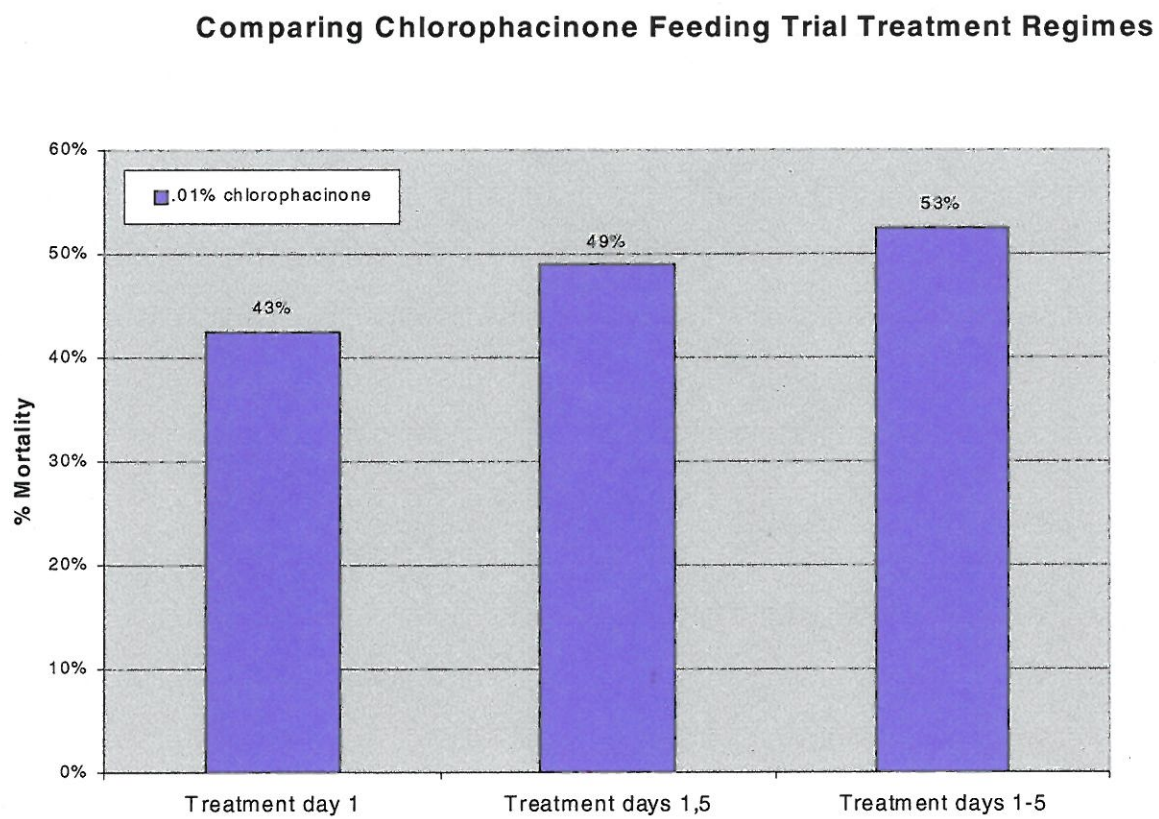
fed their regular lab diet of lab chow, artichoke bracts and water ad lib. During the entire test, animals were observed for any signs of anticoagulant toxicosis.

Group 4a- All animals were weighed prior to the treatment day. 5 mineral oil coated bracts were placed in each cage on the 1<sup>st</sup> day of the study. The animals were fed their normal lab diet of lab chow, artichoke bracts and water ad lib for the remaining 20 days of the study. Daily health checks were performed on these animals.

# **Results:**

<b>Summary Table-Group a &amp; b</b>							
Treatment group	Treatment	Schedule	# bracts/ treatment	Mortality (group a)	Mortality (group b)	Average Mortality (a & b)	Average Days to Death
1a (20 voles) & 1b(20 voles)	chlorophacinone. bracts	Day 1	14	40%	45%	42.5%	7
2a (20 voles) & 2b (20 voles)	chlorophacinone. bracts	Days 1,5	14	25%	73%	49%	9
3a (20 voles) & 3b (20 voles)	chlorophacinone. bracts	Days 1,2,3,4,5	5	40%	65%	52.5%	7
4a (8 voles)	mineral oil coated bracts	Day 1	5	0	-	-	-

**Figure 1.**



## **Pen Trials**

### **Description of Pens and animal housing:**

The artichoke fields in Castroville, CA are characterized by cool coastal breezes, frequent fogs and light rains. Davis, CA has frequent rain in wintertime but summers are typically hot and dry. In order to better replicate the baiting done in the artichoke fields of Castroville, we attempted to simulate the artichoke field environment in our 10x20 cement lined outdoor pens. We did this by building vole houses that created shade, and by installing a mister system that would lower the ambient temperature and raise the humidity in the outdoor pen.

### *Vole House Construction*

We started with 10 in. diameter plastic pots that we fixed with a 3-4 inch cement top. When constructing the top, we inserted a long bolt in the center of the cement so it protruded out of the cement above the pot. To create a lid we drilled holes in the center of plastic pot water catch trays and attached 2, 3 ft-1x2 in. pieces of wood at their centers so that they formed an X. Shade cloth was attached to this lid by using a staple gun. The bolt which protruded out of the cement was used to hold the lid in place and a nut kept the lid from getting blown around by the wind. A 2" diameter hole was cut into the side of each pot at ground level, and straw was placed inside to provide a burrow-like environment for the voles. Each pen contained 8 vole houses. Since voles frequently live in and under artichoke plants, the vole houses with the attached shade cloth simulated an artichoke plant.

### **Trial 1- July 30,2002**

### **Chlorophacinone Bract Efficacy Feeding Trial in Outdoor Pens—no additional food provided**

### **Methods and Materials:**

#### **Pen setup**

25 voles were placed in the 10x20 cement pen at least 2 weeks prior to study start date. The day before the start of the study, animals were removed from the pen leaving 20 animals to undergo testing. This was done because some animals are killed by aggressive voles, or otherwise die during the acclimation period. Oats, chow, and bracts were provided in ceramic bowls and aluminum chick waterers supplied water. Food and water was placed at south end of pen. Each pen was furnished with 8 vole houses (described above), which were stuffed with hay to provide adequate nesting material. Vole houses were spread out in pen so that there were 2 rows of 4 vole houses lengthwise down pen to simulate 2 rows of artichokes. All houses were about 1 meter apart. On the treatment day, treated bracts were placed in 10 small bowls next to the vole houses. This simulated a field type treatment where bracts are placed at the base of the artichoke plants.

### **Treatment Groups**

Group 1 – 20 voles from Castroville. Chlorophacinone treated bracts on day 1 of the trial.

### **Preparation of bracts**

Calculations

1502.8g artichoke bracts

55.15g mineral oil

7.8g Chlorophacinone concentrate (1.92%)

0.01% Chlorophacinone finished bait

### **Treatment Procedure**

Group 1 - 10 bowls containing 14 Chlorophacinone oil treated bracts were placed in the pen. The initial bract mass at the start of the trial was 776.3g. Bracts were left in pen for three days and were then removed and weighed. No food beside the treated artichoke bracts was given to animals for the 3-day treatment period. The animals were returned to their normal ad lib feeding regime of lab chow, crimped oats, artichoke bracts and water for the remaining 18 days of the study.

### **Results:**

By the 11<sup>th</sup> day of the trial all 20 animals were dead. External examinations and necropsies indicate that the animals died from anticoagulant toxicity.

### **Bract Bait Consumption**

The total bract mass that was put out at the start of the trial was 776.3g. The total bract mass after 3 days was 154.5 grams. A previous desiccation trial revealed that bract mass decreases by approximately 37% after 3 days. Therefore we estimate that approximately 384.4g of bract bait was consumed or taken by animals.

### **Trial 2-September 9, 2002**

### **Chlorophacinone Bract Efficacy Feeding Trial in Outdoor Pens –additional food provided**

### **Methods and Materials:**

#### **Pen setup**

25 voles were placed into a 10x20 cement pen at least 2 weeks prior to study start date. The day before the start of the study 4 animals were removed from the pen leaving 21 animals to undergo testing. Oats, chow, and bracts were kept in ceramic bowls and aluminum chick waterers provided water. Food and water was placed at south end of pen. Pen was furnished with 8 vole houses (described above), which were stuffed with hay to provide adequate nesting material. Vole houses were spread out in pen so that there were 2 rows of 4 vole houses lengthwise down pen. All houses were about 1 meter

apart. On the treatment day, treated bracts were placed in 10 small bowls placed by vole houses.

#### **Treatment Groups**

Group 1 – 21 voles from Castroville. Chlorophacinone treated bracts on day 1 of the trial remaining in the pen for a total of 3 days.

#### **Preparation of bracts**

Calculations

721.4g artichoke bracts

26.547g mineral oil

3.749g Chlorophacinone concentrate (1.92%)

0.01% Chlorophacinone finished bait

#### **Treatment Procedure**

Group 1- 10 bowls containing 14 Chlorophacinone oil treated bracts were placed in the pen. The initial weight of bracts was 721.4 grams. Bracts were left in pen for three days and were then removed and weighed on the 3<sup>rd</sup> day. Animals were given lab chow and crimped oats in addition to the treated bracts during the entire 21-day test.

#### **Results:**

This trial resulted in mortality rate of 76%. Necropsies revealed that 15 out of 16 animals showed obvious signs of internal bleeding indicating anticoagulant poisoning.

#### **Bract Bait Consumption**

The total bract mass that was put out at the start of the trial was 721.4g. The total bract mass after 3 days was 143 grams. A previous desiccation trial revealed that bract mass decreases by approximately 37% after 3 days. Accounting for this 37% loss of mass due to desiccation we estimate that approximately 353g of bract bait was consumed or taken by animals.

#### **Trial 3-November 13, 2002**

#### **Chlorophacinone Bract Efficacy Feeding Trial in Outdoor Pens –additional food provided**

#### **Methods and Materials:**

##### **Pen setup**

25 voles were placed into 10x20 cement pens at least 2 weeks prior to study start date. The day before the start of the study excess animals were removed from the pen leaving 20 animals to undergo testing. Oats, chow, and bracts were kept in ceramic bowls and aluminum chick waterers provided water. Food and water was placed at south end of pen. Pen was furnished with 8 vole houses (described above), which were stuffed with hay to provide adequate nesting material. Vole houses were spread out in pen so that there were 2 rows of 4 vole houses lengthwise down pen and all houses were about 1 meter apart. On the treatment day, treated bracts were placed in 10 small placed near the vole houses.

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### **Trial Groups**

Group 1(pen 9) – 20 voles from Castroville. Chlorophacinone treated bracts on day 1 of the trial and remaining in the pen for 3 days.

Group 2(pen 10) – 20 voles from Castroville. Chlorophacinone treated bracts on day 1 of the trial and remaining in the pen for 3 days.

### **Preparation of bracts**

Calculations

799.9g artichoke bracts

31.77g mineral oil

5.276g Chlorophacinone concentrate (1.92%)

Used only-29.648g Chlorophacinone mineral oil solution for bracts

0.01% Chlorophacinone oil bract bait

96 bracts/pen were used instead of 140 bracts/pen

### **Treatment Procedure**

96 bracts/pen were used instead of 140 bracts/pen because of limited artichoke supply.

The reduced number of bracts used was assumed to have no affect on the study because 5 bracts /animal was thought to be sufficient.

Group 1- 96 chlorophacinone oil treated bracts were distributed among 7 bowls and were placed in pen 9. The initial weight of bracts was 415 grams. Bracts were left in pen for three days and were then removed on the 3<sup>rd</sup> day. Animals were given lab chow and crimped oats in addition to the treated bracts. The animals were returned to their normal feeding regime of lab chow, crimped oats, artichoke bracts and water ad lib for the remaining 18 days of the study.

Group 2- 96 chlorophacinone oil treated bracts were distributed among 7 bowls and placed in pen 10. The initial weight of bracts was 415 grams. Bracts were left in pen for three days and were then removed on the 3<sup>rd</sup> day. Animals were given lab chow and crimped oats in addition to the treated bracts. The animals were returned to their normal feeding regime of lab chow, crimped oats, artichoke bracts and water ad lib for the remaining 18 days of the study.

### **Results:**

At the end of the 21day observation period 80% group 1 animals were dead and 90% of group 2 animals were dead. External observation of dead animals indicated that animal deaths were due to anticoagulant toxicity. Necropsies will be performed to help verify anticoagulant toxicosis.

### **Bract Bait Consumption**

The total bract mass that was put out at the start of the trial was approximately 415g/ pen. The total bract mass after 3 days was less than 50 grams per pen and all bract remnants that were collected following the 3<sup>rd</sup> day were completely desiccated. A previous

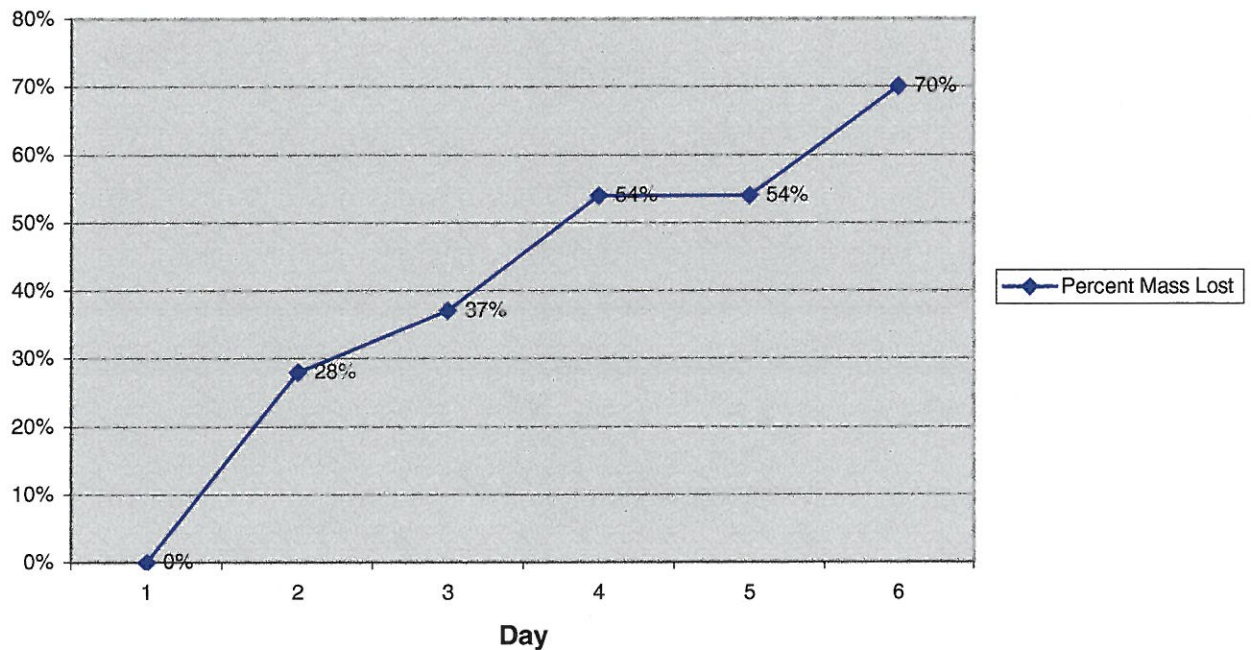
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desiccation trial revealed that bract mass decreases by approximately 37% after 3 days. Accounting for this 37% loss of mass due to desiccation we estimate that more than 220g/pen of bract bait was consumed or taken by animals.

Pen Trial	Chlorophacinone Treatment Schedule	# Bracts in Pen	Ave. Days to Death	Mortality Rate
1-no additional food provided	Day 1	140	5	100%
2-additional food provided	Day 1	140	5	76%
3(1)-additional food provided	Day 1	96	6	80%
3(2)-additional food provided	Day 1	96	7	90%

**Figure 2**

**Percent Mass Lost in Bracts From Desiccation Over Time**





## **Field Trials**

### **Introduction:**

Experimental plots were set up in Castroville artichoke fields to be baited with the new 0.28% Chlorophacinone suspension formula. In order to make an assessment of bait efficacy we developed a population indexing method that used % bract chewing as a measure of vole activity. We conducted two separate efficacy field trials. In each trial we indexed the vole population prior to treatment to get a baseline activity index. This was done by first looking for areas with burrows or plant damage assumed to be caused by voles and then putting out 10 flags in 5 of these vole damaged areas in trial 1, and 10 flags in 10 vole damaged areas in Trial 2. Three bracts were secured at each point by skewering with a metal flag wire. The 3 bracts were left out for 24 hours. Bracts were then collected and percent bracts eaten/chewed was recorded. This number was used as our pre-test activity level. We repeated the indexing method at least 7 days after the test baiting to determine the post test activity index. The activity index was obtained by comparing bract chewing before baiting and bract chewing after baiting. Control plots were set up to compare activity changes in these areas with those in the test plots.

### **Field Trial 1-August 20, 2002**

#### **Methods and Materials:**

##### **Indexing prior to baiting**

Activity indexes were performed in block 2 of Sea Mist Farms Ranch Number 5 (Desante Ranch). The block was divided into a test area and a control area. The test area was baited with the new 0.01% Chlorophacinone formulation on August 29<sup>th</sup>. The control block was left unbaited. The test area was 45.7 acres and the control block was 32.2 acres.

##### **Indexing Procedure**

Five indexing lines were set up in both the test area and the control area. Lines were chosen based on the presence of burrows. Each line had ten flags that were placed near burrows or in vole runways. Three artichoke bracts were skewered on the base of each flag and the bracts were placed near burrows where they would be the most accessible to voles. The bracts were put out in the afternoon and collected the following morning. Upon collection, the number of bracts chewed at each flag and the percent each bract eaten was recorded.

##### **Radio Tracking**

During our pre baiting indexing we set out live traps in the treatment plot. All animals caught were immediately collared with radio telemetry collars (Sirtrac, LTD,) and released at capture location. Collared animals were tracked prior to and after baiting of the field. The purpose of the tracking was to assess the efficacy of the baiting.

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**Preparation of bracts**

25 gal mineral oil

30 lbs 2% chlorophacinone powder

1.2lbs/gal

56oz chlorophacinone/mineral oil suspension /90 lbs bracts = 0.011% AI

The mineral oil/chlorophacinone suspension was prepared by Kleen Globe according to the manufacturing process developed by Kleen Globe and California Department of Food and Agriculture. Bracts were mixed with the Chlorophacinone/mineral oil suspension using large bait mixers that accommodated approximately 100 pounds of artichoke bracts. The bracts were mixed for 10 minutes or until mixture appeared to be uniformly distributed among bracts.

**Treatment of artichoke field plots**

Artichoke fields were baited with the 0.01% chlorophacinone treated artichoke bracts by Sea Mist Farm Field workers. Baiting was done by hand and was carried out according to the normal baiting protocol, i.e. 5-7 bracts were placed at the base of every other artichoke plant.

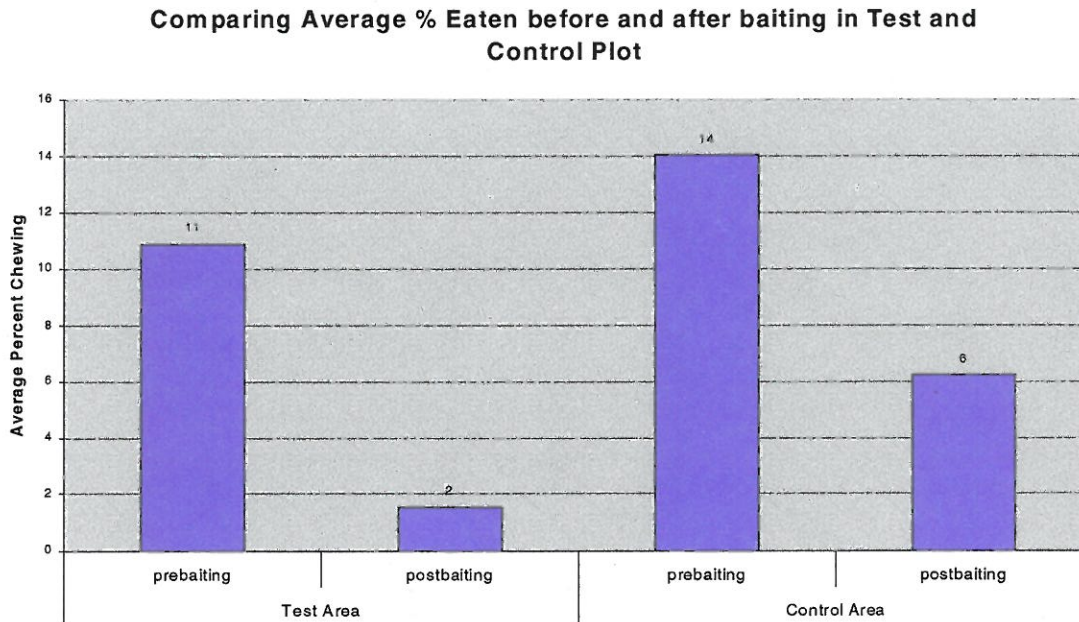
**Post baiting Indexing**

Six days after Desante Ranch block 2 was treated with the new Chlorophacinone formulation, we performed a post-bait activity index using the same procedure used for the pre bait activity index.

**Results:****Radio Tracking Results**

Four voles were tracked from August 22—September 11<sup>th</sup>. All voles were located at their capture/release point during each tracking event. On September 11<sup>th</sup> (12 days after the baiting), we tracked the position of each vole and then searched in burrows to collect dead animals. We found two collars with animal remnants attached, one dead animal where we had tracked a collar but found no collar, and one live animal with a collar. We found bract bait in the burrows where the dead voles were found and therefore assume the cause of death to be poisoning.

**Figure 3**



There was a 62% reduction in number of bracts chewed in the test block following the chlorophacinone treatment. In averaging percent eaten (out of 3 bracts) per flag we found an 86% reduction in the test area after baiting. The percent eaten per flag is what we decided to use as our vole activity index because comparing number of bracts chewed would not allow us to consider differential chewing which we assume represented different levels of activity. General field observations seemed to indicate a large decrease in number of active burrows compared to the control plots although the changes were not quantified. Bract bait was seen near burrows or pulled inside burrows and many burrows that were active during the pre test period were inactive.

In the control area there was a 33% reduction in chewed bracts prior to baiting in the test block and a 57% reduction in amount eaten. Field observations of the control block did not reveal a drastic decrease in burrow activity from the pre to the post-indexing period. We would expect that some burrow change occurs naturally as animals die or are removed by predators. The reduction in bract chewing and average amount eaten per flag in the control area may also have been due to the higher temperatures that were present during our post-baiting indexing as voles tend to be less active as temperatures increase.

The results of the activity indexes suggest that the 0.01% chlorophacinone baiting decreased vole activity. We believe this represents a decrease in the vole population.

The radio tracking indicated a 75% mortality, but the small sample size (n= 4) prohibits much inference from this aspect of the study.

## **Field Trial 2-September 23, 2002**

### **Methods and Materials:**

#### **Indexing prior to baiting**

Activity indexes were performed in Sea Mist Farms Ranch Number 6 (Sella Ranch). The block was divided into a test area and a control area. The test area was scheduled to be baited with the new Chlorophacinone formulation on September 24<sup>th</sup> and 25<sup>th</sup> and the control block was not treated. The test area was 38 acres and the control block was 4.5 acres.

#### **Indexing Procedure**

Five indexing areas were set up in rows of the test area and the control area. These sample lines were chosen based on the presence of burrows. Each line had ten flags that were placed near burrows or in vole runways. Three artichoke bracts were skewered on the base of each flag and the bracts were placed near burrows where they would be the most accessible to voles. The bracts were put out in the afternoon and collected the following morning. Upon collection, the number of bracts chewed at each flag and the percent each bract eaten was recorded.

#### **Preparation of bracts**

25 gal mineral oil

30 lbs 2% chlorophacinone powder

1.2lbs/gal

56oz chlorophacinone/mineral oil suspension /90 lbs bracts = 0.011% AI

Bracts were mixed with the Chlorophacinone/mineral oil suspension using large cement mixers. The bracts were mixed for 10 minutes or until mixture appeared to be uniformly distributed among bracts.

#### **Treatment of artichoke field plots**

Artichoke fields were baited with the 0.01% chlorophacinone treated artichoke bracts by Sea Mist Farm Field workers. Baiting was done by hand and was carried out according to the normal baiting protocol, i.e. 5-7 bracts were placed at the base of every other artichoke plant.

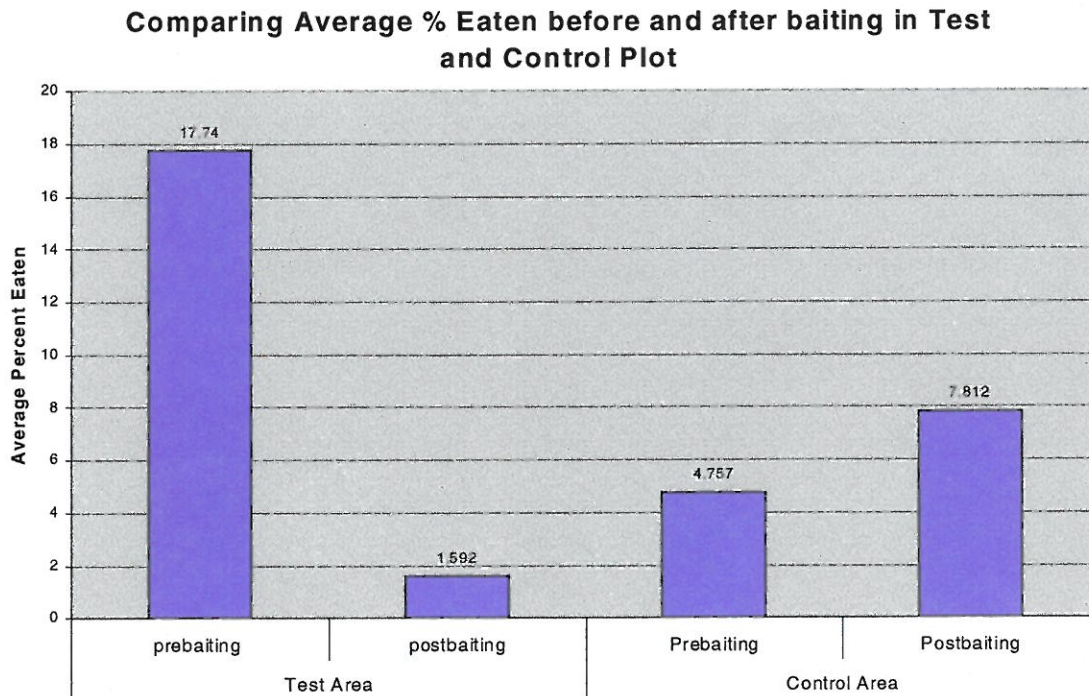
#### **Post baiting Indexing**

14 days after the test block in Sella Ranch was treated with the new Chlorophacinone formulation we performed a post-bait activity index using the same procedure used for the pre bait activity index.



## Results:

**Figure 4**



There was a 90.4% reduction in average percent eaten (out of 3 bracts) per flag in the test block following the chlorophacinone treatment. The percent eaten per flag is what we decided to use to look at voles activity because comparing number of bracts chewed does not accurately represent the amount of eating taking place, as a bract with minimal chewing would be considered equal to one that was fully chewed. Field observations seemed to indicate a large decrease in number of active burrows compared to the control plots although the changes were not quantified. Bract bait was seen near burrows or pulled inside burrows, suggesting that the reduction in activity was due to the Chlorophacinone treatment.

In the control area there was a 38% increase in the Average % eaten prior to baiting in the test block. This 38% increase in activity could be due to more favorable environmental conditions during the post baiting indexing period which may have increased foraging, or from mortality and natality cycles that cause populations to fluctuate in size over time.

The results of the activity indices suggest that baiting with 0.01% chlorophacinone treated bracts decreased vole activity, which we interpret as a decrease in the vole population. Field observations also seemed to indicate that the treatment reduced vole numbers.

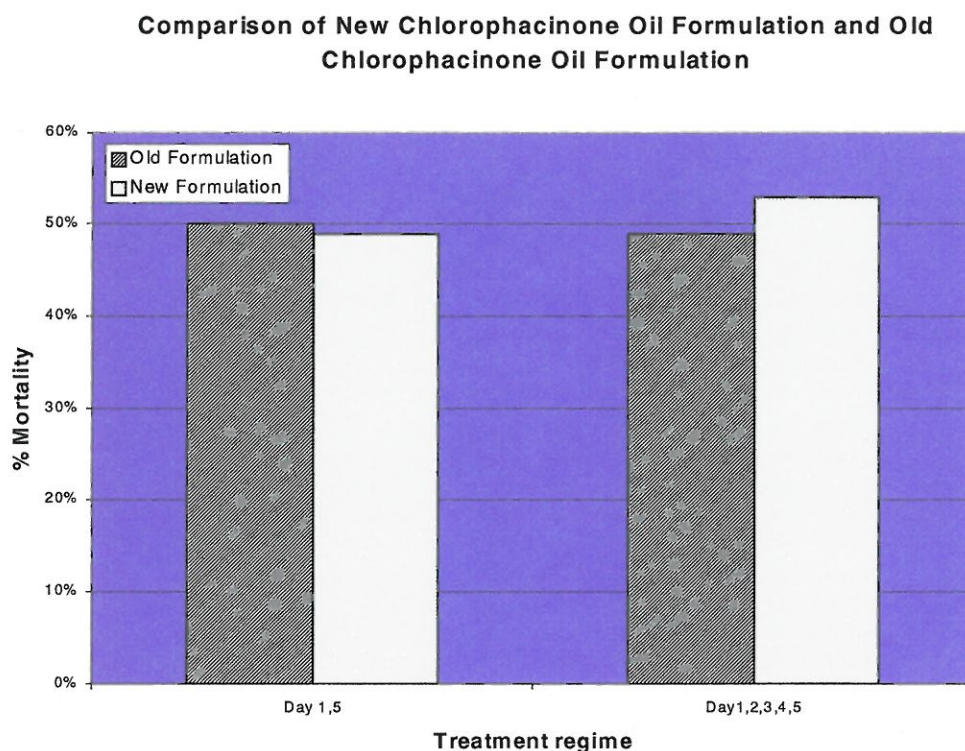
## **Discussion and Conclusion**

In testing the efficacy of the new formulation we looked first at cage trials, then outdoor pen trials, and finally a series of trials in commercial artichoke fields.

### **Summary of Cage Trials-**

Taking into account all treatment regimes, the cage trials produced mortality rates ranging from 25% to 73%. The Day 1 treatment regime produced an average 43% mortality rate, the Day 1,5 treatment regime produced an average mortality rate of 49% and the Day 1,2,3,4,5 treatment regime produced an average mortality rate of 53%. In previous feeding trials we looked at the currently used Rozol oil formulation and in comparing trials receiving the same treatment regime we found the 2 formulations to have comparable efficacy results (days 1,5 - 50% and days 1,2,3,4,5 - 49%).

**Figure 5**

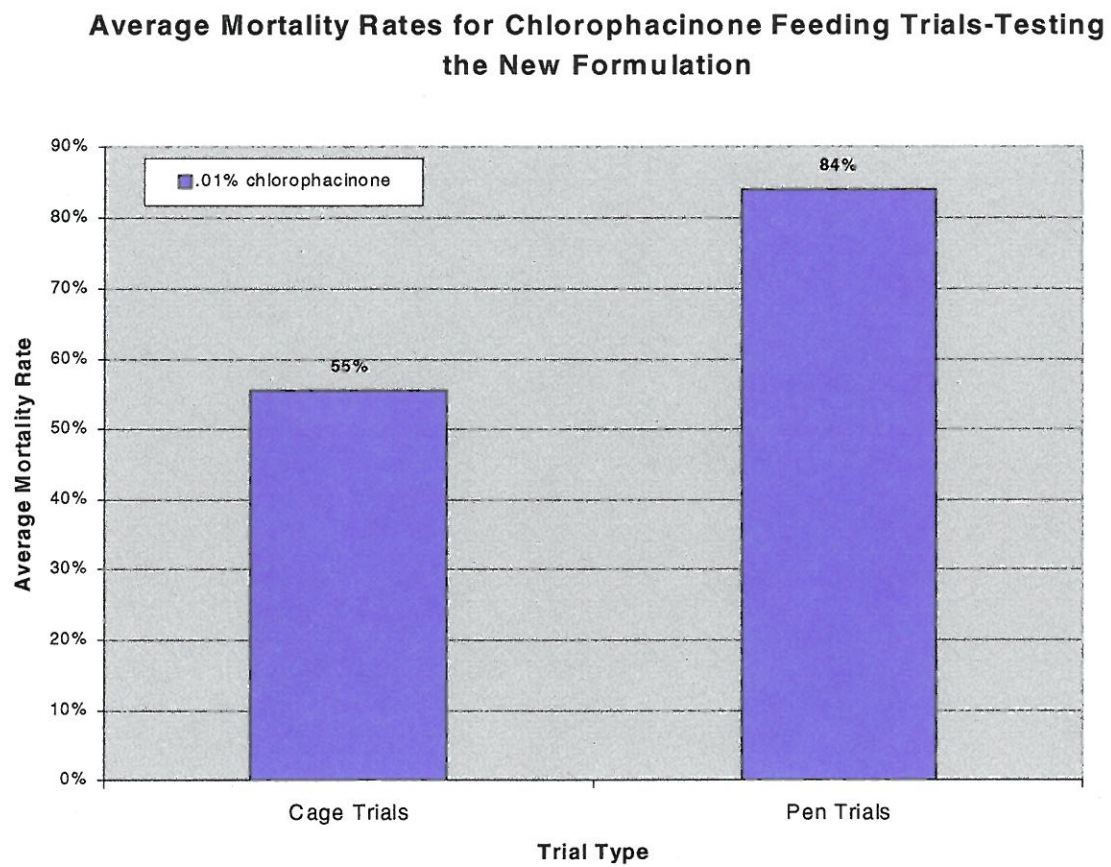


**Summary of Pen Trials-**

The chlorophacinone bract bait feeding trials conducted in the outdoor pens tested 2 different treatment situations; feeding animals treated bracts with no additional food, and feeding animals treated bracts along with their regular lab diet. Mortality rates ranged from 76% -100%. As expected, we saw a higher mortality rate in the trial that did not provide additional food. The trials that provided alternative food are likely more representative of baiting in artichoke fields where alternative food is abundant. We feel the mortality rates produced in these trials are more representative of the efficacy of the new formulation

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**Figure 6**



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#### Summary of field trials-

The final step in testing the efficacy of the new formulation was to conduct chlorophacinone bract bait field trials in Castroville artichoke fields. Conducting feeding trials in artichoke fields is difficult because population size is large and variable over time. Determining the actual number of animals is nearly impossible. In order to assess the efficacy of the new formulation we looked at vole activity before baiting and compared it to vole activity after baiting. We sampled areas where fresh vole damage was seen and in these areas bracts were put out and marked by flags. Total percent of bracts eaten was used as an index for activity. In the August field trial there was an 86% decrease in % bracts eaten/flag following treatment of the artichoke field. In the September trial, there was a 90% decrease. We cannot assume that the % decrease in bract chewing represents the actual decrease in population. However, the decrease in activity suggests that vole numbers were decreased by a significant amount.

#### Overall Summary-

The newly formulated 0.28% chlorophacinone/mineral oil suspension performs in a very similar manner to the original 0.28% Rozol chlorophacinone oil. While the manufacturing process is somewhat different, the use of the finished bait remains the same. In looking a efficacy of the new material in the laboratory and field, the overall efficacy appears substantially the same as the Rozol oil. The proposed change in the manufacturing process should have no negative impact on the overall efficacy of the 0.01% Chlorophacinone treated artichoke bracts.

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