Annual Report - 86-C9

14th ANNUAL ALMOND RESEARCH CONFERENCE, DECEMBER 2, 1986, SACRAMENTO

Project No. 86-C9--Navel Orangeworm, Mite & Insect Research
Insect Monitoring and Peach Twig Borer Trap Analysis

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Objectives: (1) Monitor levels of navel orangeworm peach twig borer, San Jose scale and oriental fruit moth in impacted growing areas of the state on an ongoing basis in order to develop or refine phenology models. (2) Make information available to growers in a timely manner through local Cooperative Extension Farm Advisors. (3) Summarize flight activity data on a yearly basis in relation to degree-days. (4) Analyze peach twig borer pheromone trap records from the past several years which have been obtained from several Cooperative Extension advisors to see if climatic factors or population abundance could explain the "twin peaks" (for a single flight) being observed in many areas.

Interpretive Summary: Trapping supplies were purchased for UC farm advisors who wished to participate in the survey of navel orangewrom peach twig borer, and San Jose scale flights initiated this season. Farm advisors receiving these supplies were Wilbur Reil (Yolo Co.), Lonnie Hendricks (Merced Co.), Bill Krueger (Glenn Co.), Joe Connell (Butte Co.), Janine Hasey (Sutter-Yuba Co.), Walt Bentley (Kern Co.), John Edstrom (Colusa Co.), Don Rough (San Joaquin Co.), Mark Freeman (Fresno Co.), and Rich Coviello (Fresno Co.). This data will be assembled and summarized on a seasonal basis in terms of degree-days. A "Trap Count" program was written to facilitate data entry, calculation, and graphing to make this process more efficient. The data is being used to confirm or improve our observations on flight phenology of these insects.

An analysis was conducted to try to find interpretations of the "twin peaks" of peach twig borer flights that have been observed. Peach twig borer trapping data was provided by UC farm advisors and researchers from 63 orchards representing 12 counties and 10 years. The results of this study indicated that the generation times currently used are correct, and that this does not vary by location or by generation. "Twin Peaks" are more likely to occur in the Sacramento Valley than in the San Joaquin Valley, and the phenomenon tends to become less common in the more southern growing areas. The climatic factor that best fit the "twin peaks" phenomenon was cold nightly temperatures during the flight period of the overwintering population. When temperatures dropped below 57°-61°F in the midnight to 4:00 a.m. period, moth trap catches were drastically reduced. This may be due to reduced moth flight or to reduced catches in the pheromone traps. When there was a single trap peak, it occurred at 369°D. When "twin peaks"

occurred, they were found at 233°D and again at 660°D. When "twin peaks" occurred and the orchard was not sprayed "twin peaks" were also found in subsequent generations that year. The occurrence of twin peaks does not appear to be related to the abundance of moths in a given orchard. Data collected by Stanley Bailey in 1940-42 and more recently by Bill Barnett, Rick Hopkins, and Frank Zalom show a single emergence pattern from the hibernaculae by overwintering larvae. This would indicate that moths are present in all orchards as if there were single peaks, but that moths caught in the traps under certain conditions show the "twin peaks" phenomenon.

When using pheromone traps to monitor peach twig borers, start accumulating degree-days when the first moth has been trapped. If moth trap counts decline prior to 400°D, check the low temperature at that time. If the low temperatures are below 57 to 61°F, you will have a "twin peak". If a spray is required, use a material such as Guthion timed at about 450°D which will appear to be the middle of the twin peaks. This should control larvae resulting from the "first peak" and have enough residual to control larvae from the "second peak".

The objectives for our 1986 almond research sponsored by the Almond Board of California were:

1 & 2) To monitor levels of insect pests in impacted growing areas of the state with traps to refine phenology models and to make this information available to growers and consultants through their local Cooperative Extension Farm Advisors.

3) Summarize flight activity data on a yearly basis in relation to degree-days.

4) Analyze peach twig borer pheromone trap records from the past several years which were obtained from Cooperative Extension Advisors to see if climatic factors or population abundance could explain the "twin peaks" of moth flights often observed.

In addition, we tested several commercially available lures and traps for efficacy in capturing peach twig borer moths. We also collaborated with Karen Klonsky and John Baritelle in a USDA-sponsored case history study of IPM implementation in almonds.

Objectives 1, 2 and 3: Insect Monitoring

The management of navel orangeworm, peach twig borer, San Jose Scale and oriental fruit moth plays an important role in almond production. Monitoring these pests can provide information on the biology and abundance of the pests with such benefits as improved spray timing. We proposed a continuing project beginning in 1986 to monitor these pests in many principal growing areas with the cooperation of the local Cooperative Extension Farm Advisors. In order for them to do this, traps and lures must be purchased for their use. We have tried to do this from other funds and the Almond Board IPM Project in the past.

The monitoring portion of this proposal has both long term and short term benefits for the industry. Monitoring the flights of these pests over a number of seasons will permit analysis of climatic impacts upon the pests to refine existing phenology. Monitoring flights in each area will permit local observations to be made on a timely basis during the season, and will also permit Statewide summaries to be made at the end of each season.

In 1986, 10 Farm Advisors received trapping supplies as part of this project. These individuals requested supplies in response to an inquiry we made last winter. The cooperating Farm Advisors and their counties (in parentheses) were: Walt Bentley (Kern Co.), Joe Connell (Butte Co.), Rich Coviello (Fresno Co.,) John Edstrom (Colusa Co.), Mark Freeman (Fresno Co.), Janine Hasey (Sutter/Yuba Co.), Lonnie Hendricks (Merced Co.), Bill Krueger (Glenn Co.), Wilbur Reil (Yolo Co.), and Don Rough (San Joaquin Co.). These individuals contributed their time in monitoring the traps and reporting results.

In 1986, the UC/IPM Implementation Group with the special assistance of Joyce Fox produced a microcomputer program called "Trap Counts." This program is being used to compile and graph the 1986 data obtained and has been provided to the Farm Advisor cooperators for their use in the future. This will help us automate the data collection, data analysis and graphing of trap counts, making future reports more timely.

Results of the insect monitoring objective for 1986 are provided in the Appendix at the end of this report.

We intend to use this information to verify parameters in the field version of the navel orangeworm model and to confirm the results of this year's peach twig borer analysis.

Objective 4: Peach Twig Borer

A phenology model for peach twig borer has been developed for almond and is in wide use. A phenomenon associated with this model in which two peaks of flight activity apparently occur has been widely noted. It is possible that either some climatic conditions or a sufficiently high level of flight activity is associated with the phenomenon.

We assembled 63 data sets from Farm Advisors and researchers taken in 12 counties over a 10 year period (Table 1). We used these data to characterize orchards and parameters with the presence or absence of "twin peaks".

Characteristics of location and date--Not all locations were presented in all years. Therefore, grouping of orchards had to be made in order to permit analysis. For example, all useable data sets from the Sacramento Valley and the Southern San Joaquin Valley were collected in the period 1981-1984. Data sets collected prior to that time were only represented by central San Joaquin Valley orchards (principally provided by Dr. Dick Rice and Bill Barnett). When the occurrence of "twin peaks" to single peaks were compared by chi-square analysis for the central San Joaquin Valley orchards between years, no significant difference was observed (Table 2). However, it was interesting to note that no "twin peaks" were observed prior to 1980. When the occurrence of "twin peaks" was compared to single peaks by chi-square analysis for all orchards in the period 1981-84, a significant difference was observed by location (Table 3). In this case, orchards in the Sacramento Valley were more likely to have "twin peaks" than orchards in the San Joaquin Valley.

Moth density--To test the hypothesis that moth density during the first PTB flight was a factor in the "twin peak" phenomenon, the total number of moths caught during the first flight was compared for orchards exhibiting single peaks and "twin peaks". Table 4 shows the results of this analysis. There was no significant difference in total moth catch between orchards exhibiting one peak or 2 peaks.

Temperature and windspeed--It was assumed that temperatures and windspeeds during moth flight prior to the first peak might be different than those observed after the first peak in orchards exhibiting "twin peaks". To test this, we selected all orchards for the data set for which we had hourly temperatures between midnight and 4 a.m., the period during which researchers have determined that PTB moths fly. We compared the mean temperature and windspeed during the flight period for 6 moth trap intervals by analysis of variance and Duncan's multiple range test. The trap intervals were: 1) the 10 days prior to the start of moth flight, 2) the period between initiation of moth flight and peak moth catch for orchards with 1 peak (Figure 1 top), 3) the 10 days prior to the start of moth flight, 4) the period between initiation of moth flight and the first peak moth catch, 5) the period between first peak moth catch to the point of lowest moth catch, and 6) the point of lowest moth catch to second peak moth catch for orchards with "twin peaks" (Figure 1 bottom). The results of this analysis (Table 5) showed a significantly higher temperatue ($\bar{x}$ = 68.5^{o}F) from initiation of moth flight with a single peak to the peak moth catch than was observed for the 10 days prior to the initiation of the moth flight or for any period with 2 peaks. This may be important as this analysis suggests that cooler mean temperatures during moth flights might result in the "twin peaks" phenomenon. The results of the analysis for windspeed was less conclusive as the mean windspeed for each period appeared to be positively correlated to mean temperature. This might be explained by the fact that temperatures are generally colder on still nights.

Temperature thresholds--Dr. Dick Rice made the observation that PTB moths appeared to fly when temperatures were in excess of 60^{o}F. This observation was incorporated in the UC publication Integrated Pest Management for Almonds as a guideline for using the PTB phenology model. To test this observation using our data sets, we compared the number of days that minimum temperatures fell below 10^{o}C (50^{o}F), 12^{o}C (53.6^{o}F), 14^{o}C (57.2^{o}F), 16^{o}C (60.8^{o}F), and 18^{o}C (64.4^{o}F) for 8 moth trap intervals by analysis of variance and Duncan's multiple range test. The trap intervals were: 1) the 10 days preceding the start of the moth flight divided by 2, 2) the 5 days immediately prior to the peak moth catch, and 3) the 5 days immediately following the peak moth flight for orchards with 1 peak (Figure 2 top), and 4) the 10 days preceding the start of the moth flight divided by 2, 5) the 5 days immediately prior to the first peak moth catch, 6) the 5 days immediately following the first peak moth flight, 7) the 5 days immediately prior to the second peak moth catch, and 8) the 5 days immediately following the second peak moth catch (Figure 2 bottom).

The results of this analysis (Table 6) showed that for orchards with 1 peak there was a significant difference in days with minimum temperatures in excess of 10°C, 12°C, 14°C, 16°C and 18°C for the period prior to initiation of flight than for the periods before and after peak moth catch. There was no significant difference in days with minimum temperatures in excess of the 5 tested thresholds before or after peak moth catch.

For orchards with 2 peaks (Table 6), the number of days with minimum temperatures in excess of 14°C and 16°C for the period prior to the first peak moth catch was significantly higher than for the period after the first peak moth catch. There was no significant difference in days with minimum temperatures in excess of 10°C, 12°C 14°C, 16°C, and 18°C for the period before or after peak moth catch for the second peak moth catch, and these values tended to be greater than the corresponding values for the first peak moth catch.

The results of this analysis indicate that there is a suppression of PTB moth trap catch when minimum temperatures fall below 14°C (57.2°F) and 16°C (60.8°F) during the flight. The trap catch increases again when temperatures meet or exceed these minimum temperatures for over 3.8 of 5 days (57.2°F) or 2.5 of 5 days (60.8°F).

Phenology of overwintering generation moth flight--The mean degree-day accumulation for the overwintering generation as measured from first moth catch to first moth catch in the subsequent generation was 1066.16 (Table 7). In orchards with a single observed peak, the peak moth catch occurred at 368.68 (Table 8). In orchards with "twin peaks", the first peak moth catch occurred at 232.90 and the second peak moth catch occurred at 659.90. All of these mean accumulations are significantly different from one another.

PTB flight phenology--There was no significant difference in mean accumulated degree-days between flights of the overwintering, first, or second generation moths (Table 7). Likewise, there was no significant difference in mean accumulated degree-days by location (Table 9). Overall, the average generation time observed in our study was approximately 1080 degree-days.

In orchards with "twin peaks"; there was no significant difference in mean accumulated degree-days between first peak moth catches and second peak moth catches amongst the generations (Table 10). This is significant as it suggests that if the "twin peak" phenomenon occurs in the overwintering generation, it will also occur in subsequent generations (unless, of course, insecticides were applied which result in the removal of one of the peaks).

"Twin Peak" discussion--Our results indicate that the generation times currently used are correct, and that this does not vary by location or by generation. "Twin Peaks" are more likely to occur in the Sacramento Valley than in the San Joaquin Valley, and the phenomenon tends to become less common in the more southern growing areas. The climatic factor that best fit the "twin peaks" phenomenon was cold nightly temperatures during the flight period of the overwintering population. When temperatures dropped below 57°-61°F in the midnight to 4:00 a.m. period, moth trap catches were drastically reduced. This may be due to reduced moth flight or to reduced catches in the pheromone traps (we do not know the mechanism). When there was a single trap peak it occurred at 369°D. When "twin peaks" occurred, they were found at 233^{O}D and again at 660^{O}D. When "twin peaks" occurred and the orchard was not sprayed "twin peaks" were also found in subsequent generations that year. The occurrence of twin peaks does not appear to be related to the abundance of moths in a given orchard. Data collected by Stanley Bailey in 1940-42 (Figure 3) and more recently by Bill Barnett, Rick Hopkins, and Frank Zalom (Figure 4) show a single emergence pattern from the hibernaculae by overwintering larvae. This would indicate that moths are present in all orchards as if there were single peaks, but that moths caught in the traps under certain conditions show the "twin peaks" phenomenon.

We suggest that when using pheromone traps to monitor peach twig borers, start accumulating degree-days when the first moth has been trapped. If moth trap counts decline prior to 400^{O}D, check the low temperature at that time. If the low temperatures are below 57 to 61^{O}F, you will have a "twin peak". If a spray is required, use a material such as Guthion timed at about 450^{O}D which will appear to be the middle of the twin peaks. This should control larvae resulting from the "first peak" and have enough residual to control larvae from the "second peak".

Additional Results:

Lures--In 1986, we compared peach twig borer lures produced by Zoecon, Scentry, and Hercon. It has been our experience that it is difficult to compare trap catches with lures produced by different companies, between years with lures of the same company, and sometimes between lots of the same company because of variability in the production process. Therefore, our results in this test are probably not broadly applicable unless future tests prove consistent with these results.

Figure 5 presents the results of this year's lure comparison. It can be seen that there was no difference in trap catches between lures for the first 8 weeks. There were 4 replications of each lure in this trial. Each lure was re-randomized in the orchard 2 times each week. Means were compared by Duncan's multiple range test. The efficacy of both the Zoecon and Scentry lures declined after the eighth week, and catches were significantly less than the Hercon lures thereafter.

Traps--In 1986, we compared six commercially available traps that are sold as being of use for "small moths". We placed 4 traps of each type in an orchard for 8 weeks. The traps were re-randomized in complete blocks 2 times each week. The mean proportion of moths caught in each trap were compared by Duncan's multiple range test. The results of this study showed that the 2 wing style traps caught significantly more moths than the other styles (Table 11).

Survey--In 1986, we completed a study of the rate and economic impact of adoption of IPM practices by California almond growers. This study was funded by the USDA and the University of California. It was conducted in close cooperation with Karen Klonsky, John Baritelle, Joe Moffit, and Bill Barnett. The study was published as part of a national impact study of IPM practices. The results showed that a majority of almond growers and/or their PCA's have adopted cultural practices for controlling the navel orangeworm, and that a significant number have adopted monitoring techniques for other insect pests. The estimated value received by the industry due to increased production, lower damage, and lower pesticide use is approximately $12 million per year.

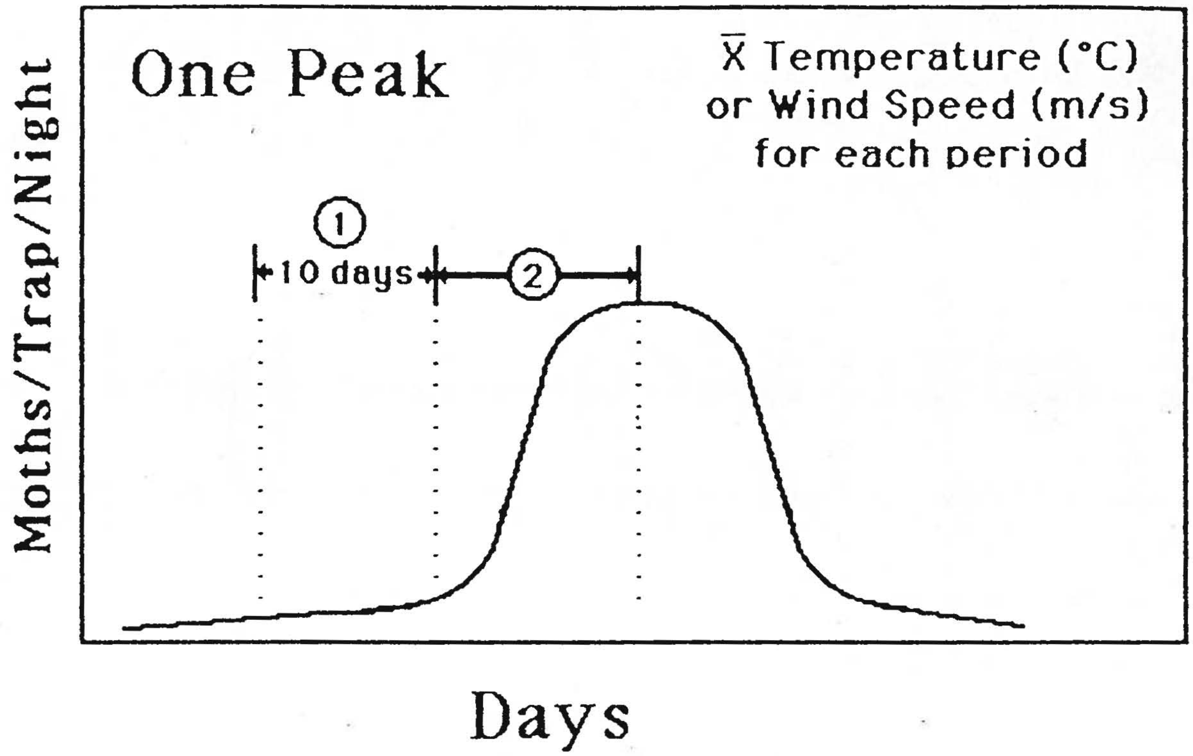
Almond Publications During This Period

Zalom, F.G. 1986. Navel orangeworm: the crop load factor. Almonds Facts 51 (3): 32-33.

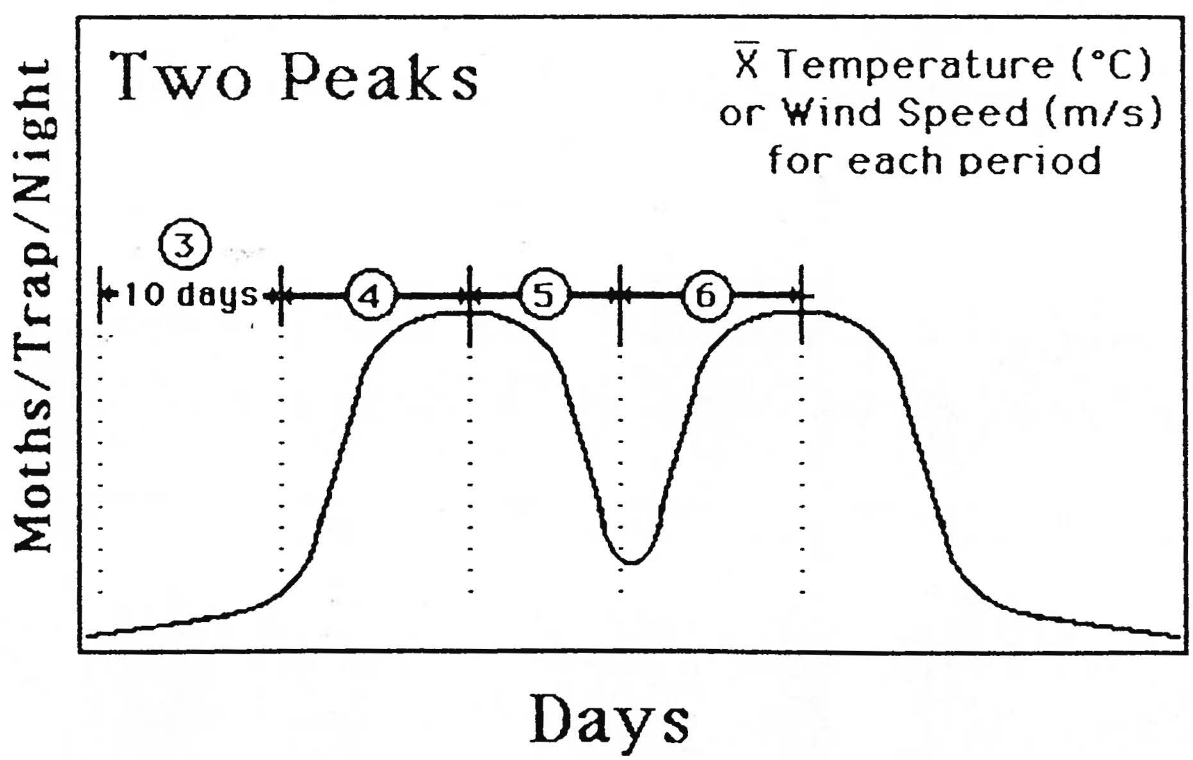
Bentley, W., F.G. Zalom, W.W. Barnett, and J.P. Sanderson. 1986. Population densities of Tetranychus spp. (Acari: Tetranychidae) after treatment with insecticides for Amyelois transitella (Lepidoptera: Pyralidae). J. Econ. Entomol. (In Press)

Zalom, F.G. and K. Klonsky. 1986. California almond impact study pp. 1-89. In W. A. Allen and E.G. Rajotte eds. The national evaluation of extension's integrated pest management (IPM) programs. Va. Coop. Ext. Service.

Figure 1.

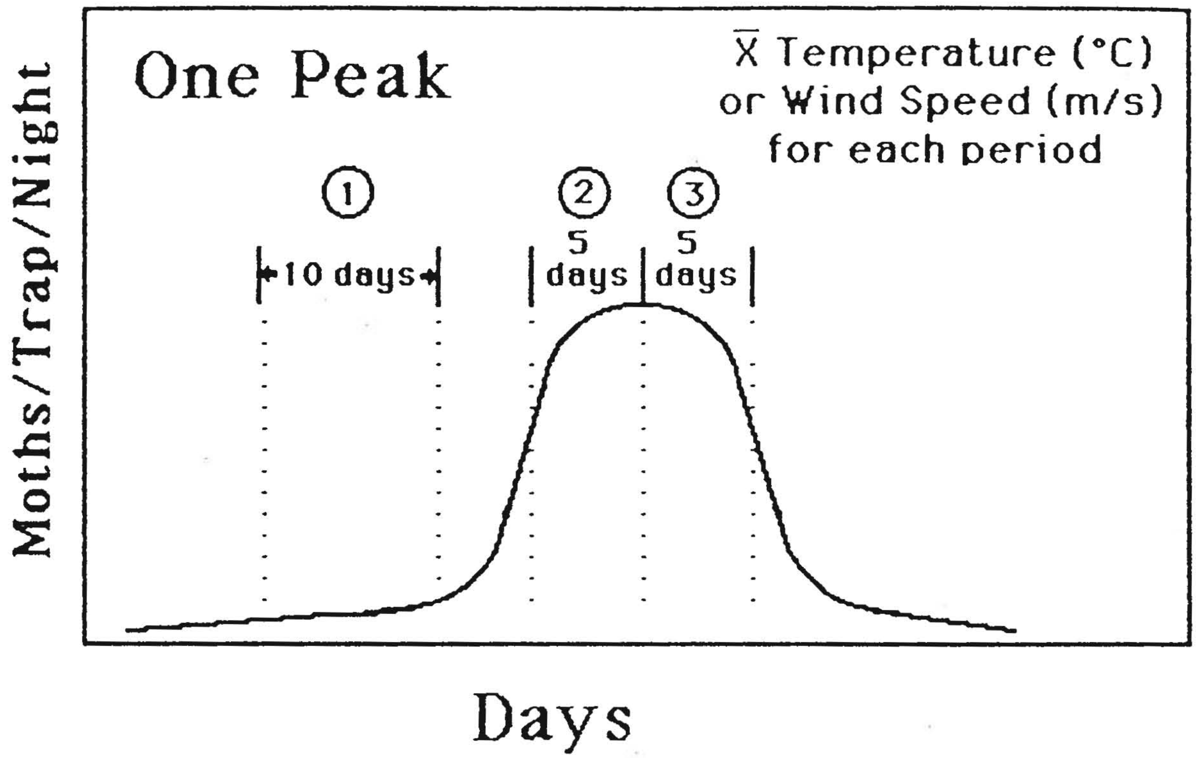


One Peak
X̄ Temperature (°C)
or Wind Speed (m/s)
for each period
1
10 days
2
Moths/Trap/Night
Days

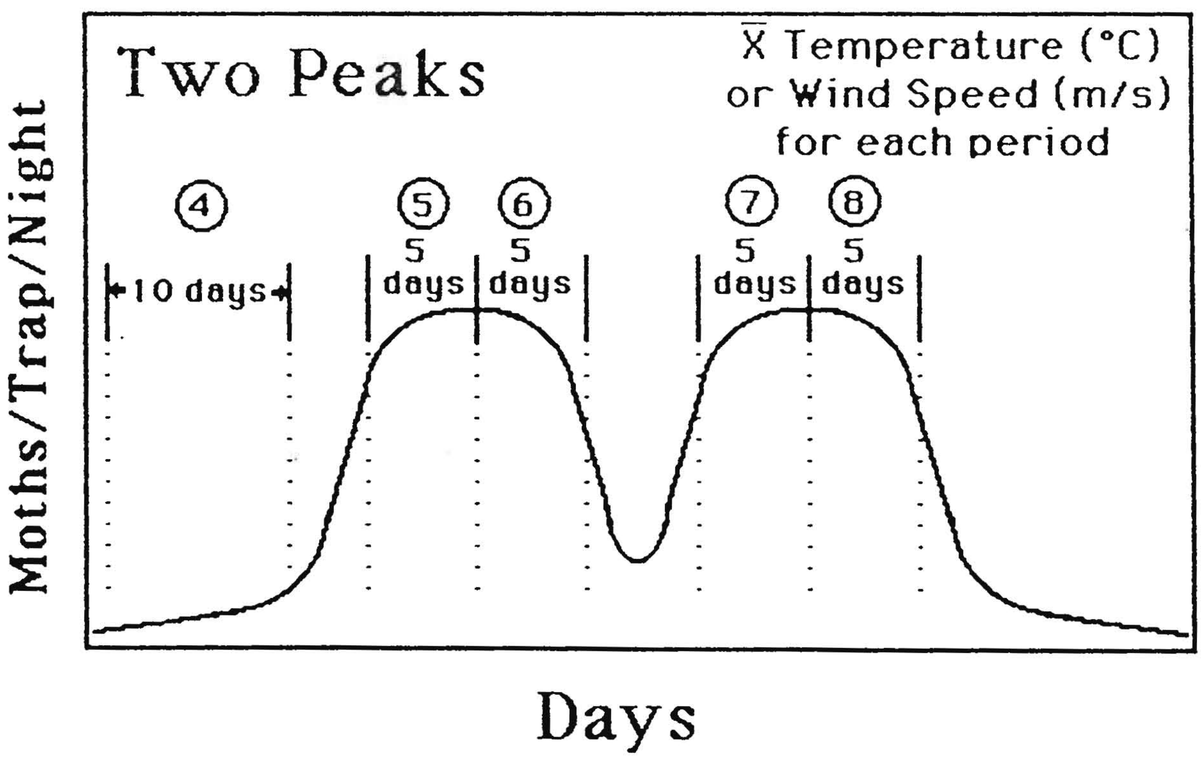


Two Peaks
X̄ Temperature (°C)
or Wind Speed (m/s)
for each period
3
10 days
4
5
6
Moths/Trap/Night
Days

Figure 2.



One Peak
X̄ Temperature (°C)
or Wind Speed (m/s)
for each period
1
2
3
10 days
5
days
5
days
Moths/Trap/Night
Days



Two Peaks
X̄ Temperature (°C)
or Wind Speed (m/s)
for each period
4
5
6
7
8
10 days
5
days
5
days
5
days
5
days
Moths/Trap/Night
Days

Figure 3.

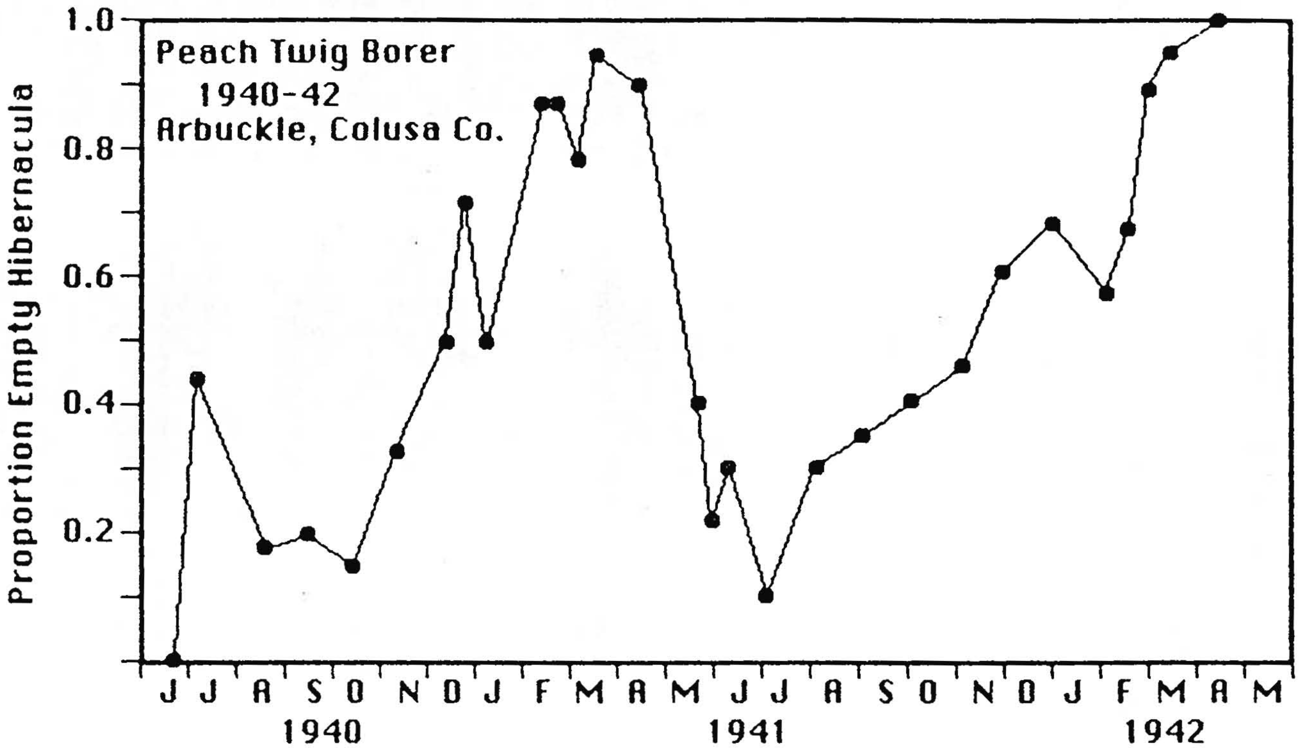
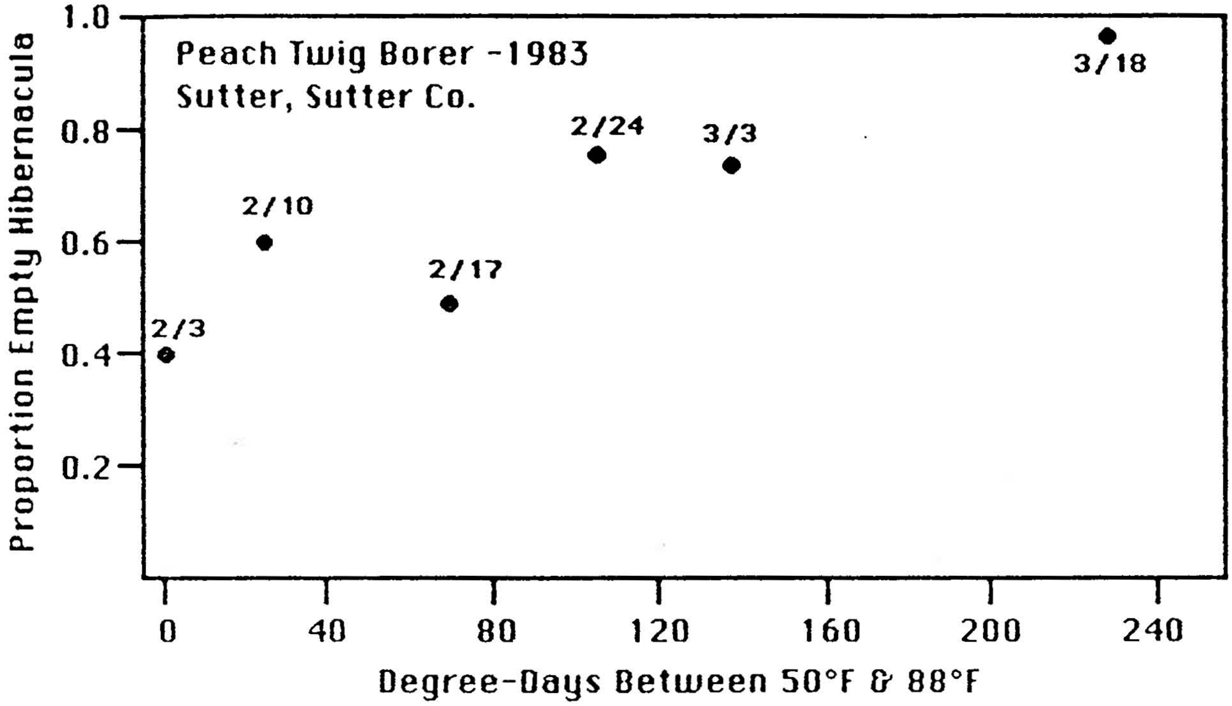
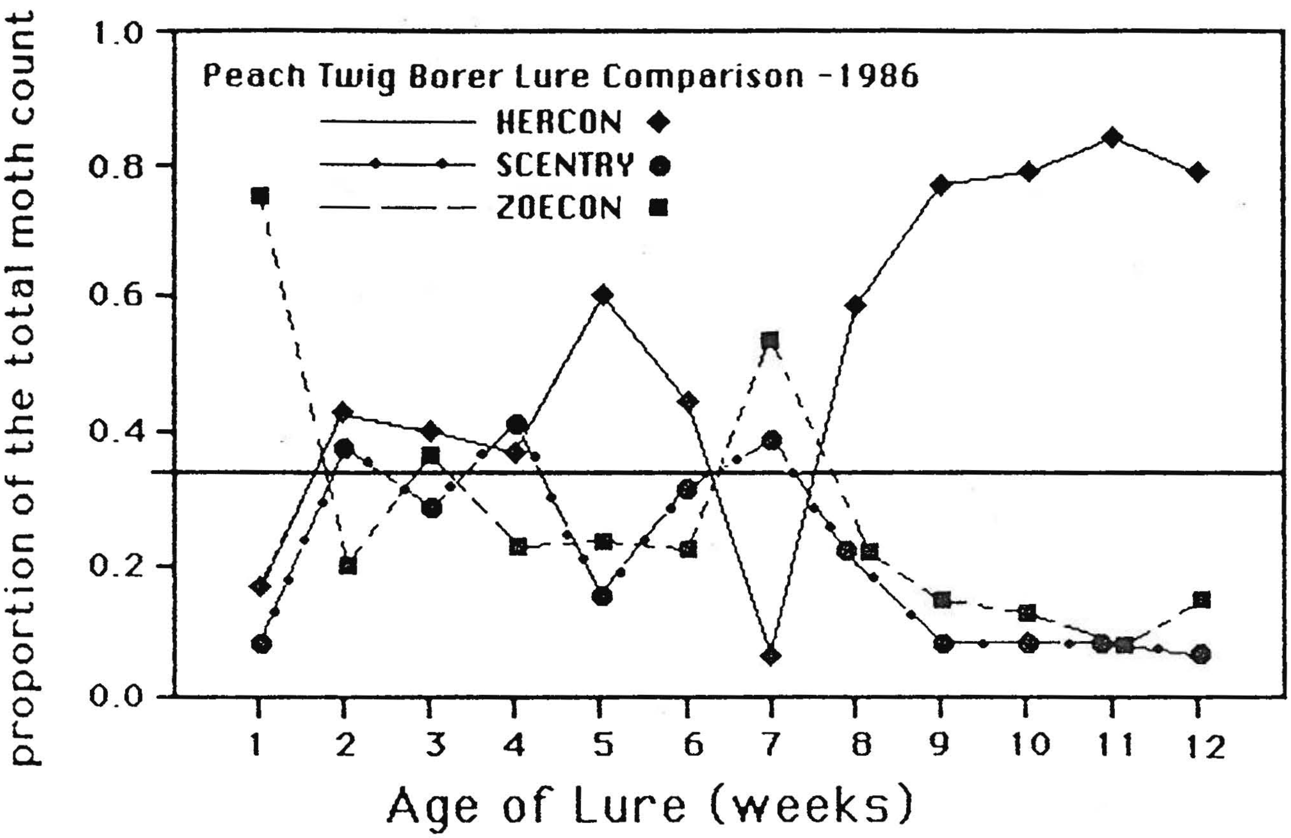

Peach Twig Borer
1940-42
Arbuckle, Colusa Co.
Proportion Empty Hibernacula
1.0
0.8
0.6
0.4
0.2
J J A S O N D J F M A M J J A S O N D J F M A M
1940
1941
1942

Figure 4.



Peach Twig Borer -1983
Sutter, Sutter Co.
Proportion Empty Hibernacula
1.0
0.8
0.6
0.4
0.2
2/3
2/10
2/17
2/24
3/3
3/18
0
40
80
120
160
200
240
Degree-Days Between 50°F & 88°F

Figure 5.



Peach Twig Borer Lure Comparison -1986
HERCON
SCENTRY
ZOECON
proportion of the total moth count
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
8
9
10
11
12
Age of Lure (weeks)

Table 1.

LOCATION AND YEAR OF ORCHARD COMPRISING SURVEY (n=63)

	PEAKS		YEARS										
County	1	2	75	76	77	78	79	80	81	82	83	84	85
Butte	4	2	--	--	--	--	--	--	1	--	3	2	--
Colusa	1	1	--	--	--	--	--	--	1	1	--	--	--
Glenn	1	3	--	--	--	--	--	--	1	2	1	--	--
Sutter	1	6	--	--	--	--	--	--	1	--	4	2	--
Yolo	0	4	--	--	--	--	--	--	4	--	--	--	--
Yuba	0	3	--	--	--	--	--	--	--	--	3	--	--
Fresno	19	5	2	2	3	2	1	3	3	2	2	2	2
Madera	1	0	--	--	--	--	--	--	--	1	--	--	--
Merced	1	3	--	--	--	--	--	--	2	1	1	--	--
Tulare	0	1	--	--	--	--	--	--	1	--	--	--	--
Kings	2	1	--	--	1	1	--	--	--	1	--	--	--
Kern	4	0	--	--	--	--	--	--	1	1	1	1	--

Table 2.

#PEAKS IN FIRST PTB FLIGHT 1975-85
CENTRAL SAN JOAQUIN VALLEY ORCHARDS ONLY

PEAKS	75	76	77	78	79	80	81	82	83	84	85	TOT.
1	2	2	3	2	1	2	2	3	2	2	0	21
2	0	0	0	0	0	1	3	1	1	0	2	8

X^2= 12.564; P=0.249

Table 3.

#PEAKS IN FIRST PTB FLIGHT
FOR ALL ORCHARDS 1981-84

Location	# of Peaks 1	2
Sacramento Valley	7	20
Cent. San Joaquin	9	5
S. San Joaquin	4	1

x^2=8.565; P=0.014**; n=46

Table 4.

TOTAL # PTB MOTHS/TRAP/NIGHT
DURING FIRST FLIGHT

#PEAKS	n	$\bar{x}$
1	34	471.1 A
2	29	327.3 A

Table 5.

PEACH TWIG BORER--TEMPERATURE AND WINDSPEED FOR PERIOD MIDNIGHT TO 4 A.M.

Interval	$\bar{x}$ Temp. (°F)		$\bar{x}$ Windspeed (miles/hr)	
1 Peak (n=8)				
1. 10 days<Flight	49.8	C	2.37	C
2. Initiation to Peak	68.5	A	3.38	A
2 Peaks (n=11)				
3. 10 days<Flight	51.1	BC	2.56	BC
4. Initiation to Peak 1	54.7	BC	2.56	BC
5. Peak 1 to Lowest Point	56.8	BC	2.97	AB
6. Lowest Point to Peak 2	59.5	B	3.38	A

Table 6.

	Number of Days with Minimum Temperature > (°C)									
	10		12		14		16		18	
1 Peak										
10 Days<flight/2	1.63	B	1.00	C	0.69	CD	0.31	D	0.13	C
5 days<peak	4.38	A	4.38	AB	3.75	AB	3.50	A	2.75	A
5 days>peak	4.75	A	4.75	A	4.38	A	3.63	A	2.25	A
2 Peaks										
10 days<flight/2	1.23	B	0.41	C	0.09	D	0.05	D	0.00	C
5 days<peak 1	4.64	A	4.36	AB	2.91	B	1.46	C	0.18	C
5 days>peak 1	4.27	A	3.55	B	1.18	C	0.36	D	0.09	C
5 days<peak 2	5.00	A	4.82	A	3.82	AB	2.55	B	0.82	BC
5 days>peak 2	4.86	A	4.86	A	3.05	B	1.82	BC	1.36	B

Table 7.

PEACH TWIG BORER
DEGREE-DAYS/FLIGHTS

Generation	n	$\bar{x}$
Overwinter	61	1066.16 A
1	50	1089.14 A
2	21	1097.33 A

Table 8.

MEAN PTB DEGREE-DAYS FROM FIRST MOTH TO LISTED EVENT FOR ALL ORCHARDS

Event	n	$\bar{x}$	
PEAK (w/1 Peak)	34	368.68	A
PEAK 1 (w/2 Peaks)	29	232.90	B
PEAK 2 (w/2 Peaks)	29	659.90	C

Table 9.

PEACH TWIG BORER
DEGREE-DAYS/FLIGHT BY LOCATION

Location	n	$\bar{x}$
Sacramento Valley	49	1080.29 A
Cent. San Joaquin	64	1078.67 A
S. San Joaquin	19	1082.53 A

Table 10.

PTB DEGREE-DAYS BETWEEN PEAKS
IN EACH GENEREATION FOR ORCHARDS
WITH TWIN PEAKS

Interval	n	$\bar{x}$
1st Peak to 1st Peak		
Overwintering--1	61	1066.16 A
1-2	50	1089.14 A
2-3	21	1097.33 A
2nd Peak to 2nd Peak--		
Overwintering-1	21	1095.86 A
1-2	16	1094.06 A
2-3	4	1130.50 A

Table 11.

COMPARISON OF TRAPS
PEACH TWIG BORER

Proportion of total moths caught per trap

Hercon Wing	0.08789	A
Pherocon Wing	0.08232	A
Large Delta	0.03802	B
IPS Tub	0.02016	BC
Pherocon II	0.01252	C
Multipher	0.00895	C

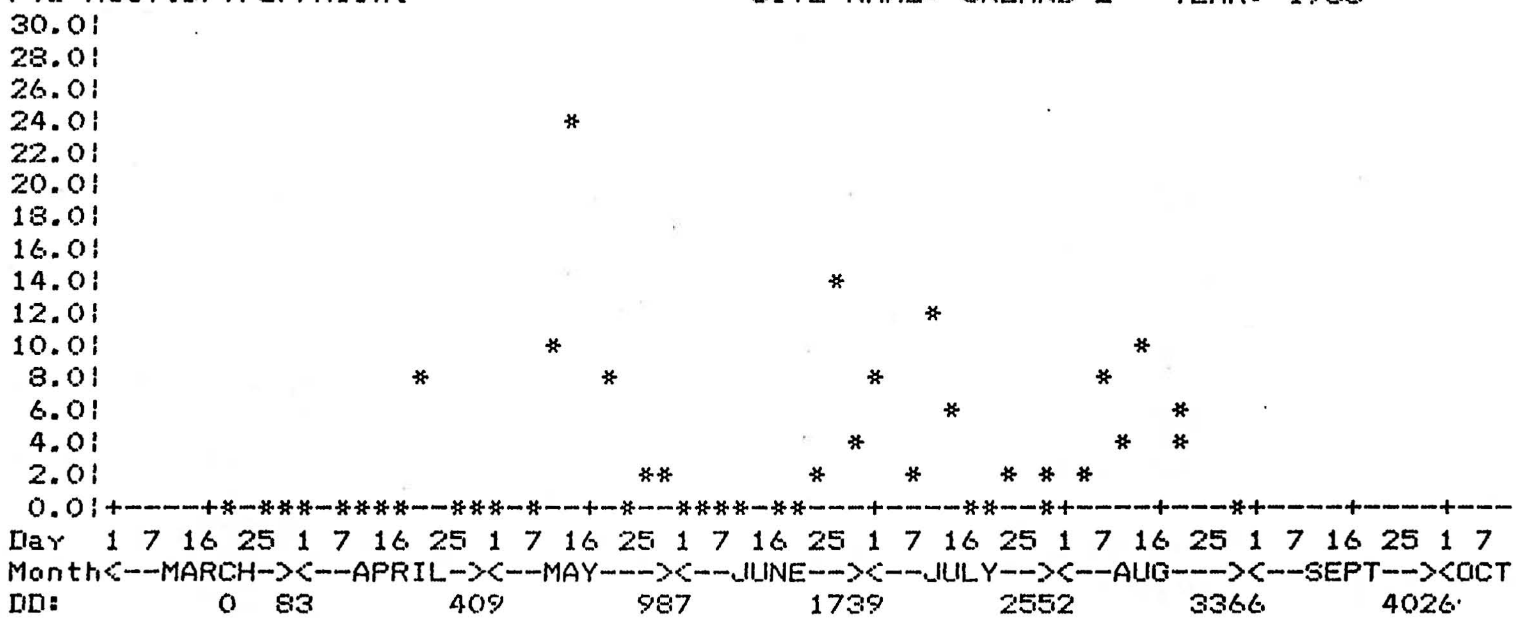
APPENDIX: TRAP COUNTS

```
                                    BUTTE CO.
PTB ADULTS/Trap/Night                  SITE NAME: DURHAM   YEAR: 1986
90.0|    OLD LURES
84.0|                                 *
78.0|
72.0|
66.0|
60.0|
54.0|
48.0|
42.0|
36.0|
30.0|
24.0|
18.0|                            **                   *       *
12.0|                                               *
 6.0|                        * *    **  *                        *
 0.0|+----+----*---**-*******-+-*--+----+**-*+-**-*----+*--*+*---+-*--+*---+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:            0       296       832      1524      2272     3028      3517
DD => Accumulated degree-days since 04/02/86 for the first day of each month.


Start date
   04/02/86
```

```
                                                           BUTTE CO.
PTB ADULTS/Trap/Night                                         SITE NAME: DURHAM    YEAR: 1986
 105|    NEW LURES
98.0|
91.0|                                 *
84.0|
77.0|
70.0|
63.0|
56.0|
49.0|
42.0|
35.0|                            *
28.0|                             *
21.0|                               *
14.0|                                   *
 7.0|                                *
 0.0|+----+----+----+----+----+----+-*--+----+**-*+-**-*----+----+----+----+----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:                                0231       924       1671      2427      2917
DD => Accumulated degree-days since 05/22/86 for the first day of each month.
```

GLENN CO.

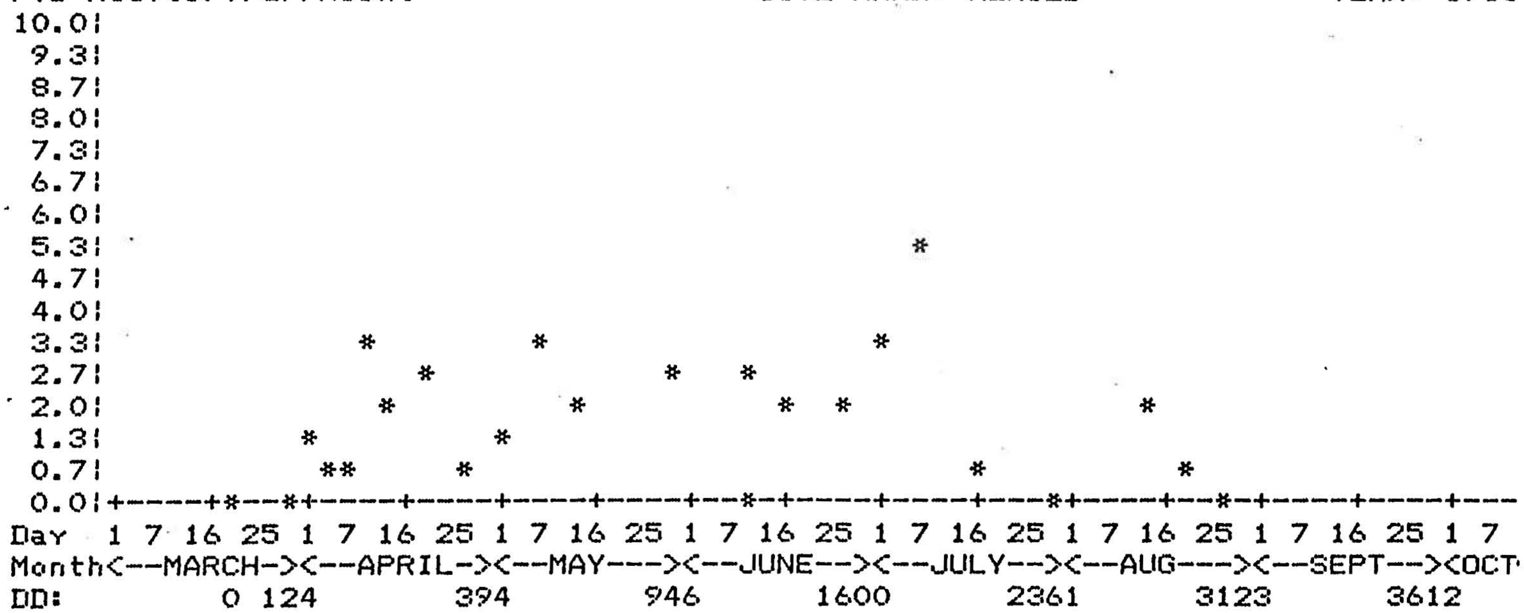
PTB Adults/Trap/Night SITE NAME: ORLAND 2 YEAR: 1986



DD => Accumulated degree-days since 03/20/86 for the first day of each month.

MERCED CO.

PTB Adults/Trap/Night SITE NAME: MERCED YEAR: 1986



DD => Accumulated degree-days since 03/21/86 for the first day of each month.

Start date
03/21/86

```
                                    SAN JOAQUIN CO.
PTB ADULTS/Trap/Night                  SITE NAME: MANTECA   YEAR: 1986
35.0|
32.7|
30.3|
28.0|                                                                     *
25.7|
23.3|                                       *
21.0|
18.7|
16.3|
14.0|                                          *                            *
11.7|                              *                    *
 9.3|                                *    *               *        *
 7.0|                                   *
 4.7|                            *               * *  *      *
 2.3|                       *  *                               * *    * *
 0.0|+----+----+-*-*+-*-*+*---+----+----+----+----+----+----+----+----+----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:              0     208       664      1216      1869      2514      2926
DD => Accumulated degree-days since 04/08/86 for the first day of each month.
```

Start date
   04/08/86

```
                                    SAN JOAQUIN CO.
PTB ADULTS/Trap/Night                  SITE NAME: RIPON   YEAR: 1986
 5.0!
 4.7!
 4.3!
 4.0!
 3.7!
 3.3!
 3.0!
 2.7!
 2.3!
 2.0!
 1.7!
 1.3!
 1.0!                              *
 0.7!
 0.3!                            *
 0.0!+----+----+----+----+----+*---+-*--*-*-*+-*-*+*--*+*-*-*--*-+----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:                            0 323     1024      1754      2515      3154
DD => Accumulated degree-days since 05/19/86 for the first day of each month.
```

Start date
   05/19/86

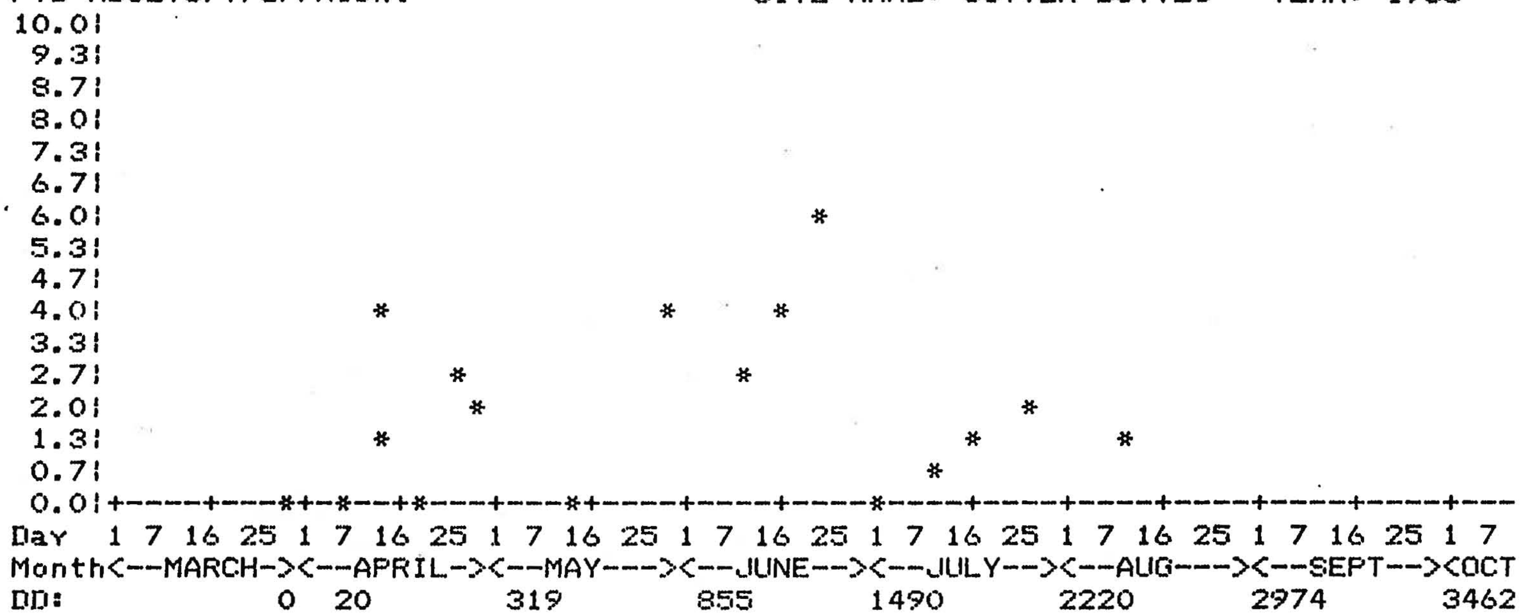
```
                                    SAN JOAQUIN CO.
PTB ADULTS/Trap/Night                  SITE NAME: TRACY   YEAR: 1986
10.0|
 9.3|
 8.7|
 8.0|
 7.3|                                                          *
 6.7|
 6.0|
 5.3|                                          *
 4.7|
 4.0|                                                        *
 3.3|                                            *               *        *
 2.7|                                                              *
 2.0|                                        *     *    *
 1.3|                                                                   *   *
 0.7|                 *     *  *                                      *
 0.0|+----+----+-*-*+---*+*---+--*-*-*--*-*--+----+---*+--*-+----+----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:              0     269       830      1506      2266      3025      3492
DD => Accumulated degree-days since 04/08/86 for the first day of each month.

Start date
   04/08/86
```

```
                                            YOLO CO.
PTB ADULTS/Trap/Night                          SITE NAME: DUNNIGAN               YEAR: 1986
25.0!
23.3!
21.7!
20.0!                                 *
18.3!
16.7!
15.0!
13.3!
11.7!
10.0!
 8.3!                *
 6.7!                            *
 5.0!                          *          *             *
 3.3!            *                               * *
 1.7!              *    * *         *   *             *        *
 0.0!+----+-*-*+----+----+--*-+----+----+---*+-*--+----+--*-+----+----+----+---
Day   1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:          0120       437        977        1660       2392       3109       3712
DD => Accumulated degree-days since 03/24/86 for the first day of each month.


Start date
   03/24/86
```

```
                                          YOLO CO.
PTB ADULTS/Trap/Night                        SITE NAME: YOLO   YEAR: 1986
 5.0|
 4.7|
 4.3|
 4.0|
 3.7|
 3.3|
 3.0|
 2.7|
 2.3|
 2.0|
 1.7|
 1.3|
 1.0|
 0.7|
 0.3|                *           *     *  * **                 *
 0.0|+-----+*--*+*****--****-**+**--***--**-*-+-*-****-*+***-*----*--*-+-----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:          0 125       401       909       1558      2261      2905      3349
DD => Accumulated degree-days since 03/21/86 for the first day of each month.


Start date
   03/21/86
```

YUBA CO.

PTB ADULTS/Trap/Night SITE NAME: SUTTER BUTTES YEAR: 1986



DD => Accumulated degree-days since 03/31/86 for the first day of each month.

Start date
03/31/86

```
                                                       BUTTE CO.
NOW EGGS/Trap/Night                                     SITE NAME: DURHAM   YEAR: 1986
 5.0|
 4.7|
 4.3|
 4.0|
 3.7|
 3.3|
 3.0|
 2.7|
 2.3|                                                              *
 2.0|                                                                *
 1.7|
 1.3|
 1.0|
 0.7|                                                        *   *
 0.3|                 *                                        *         *
 0.0|+----+----*---**--*********+*****+*-*-***-*+-**-*-*-*+*---+----+----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:           0        200       604      1161      1771      2397      2763
DD => Accumulated degree-days since 04/02/86 for the first day of each month.
```

```
                                    KERN CO.
NOW EGGS  /Trap/Night                  SITE NAME: BAKERSFIELD   YEAR: 1986
20.0|
18.7|
17.3|
16.0|
14.7|                     *
13.3|
12.0|
10.7|
 9.3|                                                   *
 8.0|
 6.7|                       *                           *             *
 5.3|                                                       *
 4.0|                                                 *   *
 2.7|                          *          *  *                       *  *
 1.3|                                   *      *      *      * *
 0.0|+----+----+----+-*--+----+-*--*-**-+---*+--*****--+----+----*----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:                   0 67       591      1221      1944      2745      3198
DD => Accumulated degree-days since 04/24/86 for the first day of each month.
```

Start date
   04/24/86

```
                                     MERCED CO.
NOW Eggs/Trap/Night                   SITE NAME: MERCED     YEAR: 1986
15.0!
14.0!                                             *
13.0!
12.0!
11.0!
10.0!
 9.0!
 8.0!
 7.0!                                        *
 6.0!                                          *      *
 5.0!                    *
 4.0!                        *                                     *
 3.0!                      *               *                 * *     *  *
 2.0!                  *
 1.0!                *         *  *                        *              * *
 0.0!+----+----*****+----+----+----+--*-*----+----+----+----+----+----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:            0       176       598      1116      1747      2382      2742
DD => Accumulated degree-days since 04/01/86 for the first day of each month.
```

Start date
   04/01/86

```
                                    SAN JOAQUIN CO.
NOW EGGS  /Trap/Night                  SITE NAME: MANTECA   YEAR: 1986
10.0|
 9.3|
 8.7|
 8.0|
 7.3|
 6.7|
 6.0|
 5.3|                                                              *
 4.7|
 4.0|
 3.3|                                                            *
 2.7|
 2.0|
 1.3|                                                                 * * *
 0.7|              *                                      *
 0.0|+----+----+-*--+-*-*+*-*-+*-*-*-*--*-*-*+-*-*+*--*+*---+*-*-+----+----+*--
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:              0     134       464       876      1384      1877      2164
DD => Accumulated degree-days since 04/08/86 for the first day of each month.
```

Start date
   04/08/86

```
                                       SAN JOAQUIN CO.
NOW EGGS   /Trap/Night                     SITE NAME: RIPON   YEAR: 1986
 5.0|
 4.7|
 4.3|
 4.0|
 3.7|
 3.3|
 3.0|
 2.7|
 2.3|
 2.0|
 1.7|
 1.3|
 1.0|
 0.7|
 0.3|
 0.0|+----+----+----+----+----+*-*-*-*--*-*-*+-*-*+*--*+*-*-*--*-+----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:                        0 273       848       1452      2085      2579
DD => Accumulated degree-days since 05/19/86 for the first day of each month.
```

Start date
   05/19/86

```
                                    SAN JOAQUIN CO.
OFM ADULTS/Trap/Night                  SITE NAME: TRACY   YEAR: 1986
 5.0¦
 4.7¦
 4.3¦
 4.0¦
 3.7¦
 3.3¦
 3.0¦
 2.7¦
 2.3¦
 2.0¦
 1.7¦
 1.3¦
 1.0¦                       *                                             *
 0.7¦                              *
 0.3¦                   *        *      *
 0.0¦+----+----+-*-*+-*--+*---+*---+-*--+-*--*-*-*+*--*+*-*-+*-*-*-*--*-*--+*--
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:              0     377      1091      1924      2848      3775      4393
DD => Accumulated degree-days since 04/08/86 for the first day of each month.


Start date
   04/08/86
```

```
                                    SAN JOAQUIN CO.
OFM ADULTS/Trap/Night                  SITE NAME: MANTECA   YEAR: 1986
30.0!
28.0!
26.0!                                                   *
24.0!
22.0!
20.0!
18.0!                                       *
16.0!                                          *
14.0!                                                      *
12.0!
10.0!                              *
 8.0!                            *        *                  * *
 6.0!                                            *    *
 4.0!                                *  *          *             *        *
 2.0!                          *
 0.0!+----+----+-*-*+-*-*+*-*-+----+----+----+----+----+----+----+-*--*-*--+*--
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:              0     302       907      1611      2423      3224      3780
DD => Accumulated degree-days since 04/08/86 for the first day of each month.
```

Start date
04/08/86

```
                                                     YOLO CO.
NOW EGGS/Trap/Night                                   SITE NAME: DUNNIGAN   YEAR: 1986
 5.0!
 4.7!
 4.3!
 4.0!
 3.7!
 3.3!
 3.0!
 2.7!
 2.3!
 2.0!
 1.7!
 1.3!
 1.0!                   *
 0.7!                          *                               *
 0.3!                     * *    *  *                     *
 0.0!+----+----+---**+*---+----+----+----+--*-*-*-*+-*-**--**+*---+----+----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:                0   142       555       1112      1715      2317      2780
DD => Accumulated degree-days since 04/15/86 for the first day of each month.


Start date
   04/15/86
```

```
                                    YOLO CO.
NOW EGGS   /Trap/Night                  SITE NAME: YOLO   YEAR: 1986
10.0|
 9.3|
 8.7|
 8.0|
 7.3|
 6.7|
 6.0|                        *
 5.3|                  *
 4.7|
 4.0|                   *
 3.3|                    **
 2.7|                       *                               *
 2.0|                *         *
 1.3|                                                          *
 0.7|                               *     **     *               *  *
 0.0|+----+----+----*----+----+-*-**-*-***--**-*--***-*+***-+----+----+----+---
Day  1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7 16 25 1 7
Month<--MARCH-><--APRIL-><--MAY---><--JUNE--><--JULY--><--AUG---><--SEPT--><OCT
DD:                 0  103       485      1004      1575      2091      2415
DD => Accumulated degree-days since 04/18/86 for the first day of each month.


Start date
   04/18/86
```