AN ABSTRACT OF THE THESIS OF

RODERICK WARD WARNER for the MASTER OF SCIENCE
(Name of student) (Degree)

in ENTOMOLOGY presented on 2/23/74
(Major) (Date)

Title: THE DIEL ACTIVITY CYCLE OF THE ADULT ALFALFA WEEVIL, HYPERA POSTICA (GUILL.), IN OREGON

Abstract approved: Redacted for privacy
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The diel fluctuations in the abundance of alfalfa weevils, as measured by sweeping, were studied during 1972 and 1973 in three of the four major alfalfa growing regions of Oregon. It was found that in all regions studied significantly more new generation adults could be captured after dark than during the day in the summer. This negative reaction to light appeared to approach an inverse linear relationship early in the summer but by the end of July a more or less "all-or-none" negative response was observed. Significant decreases in the numbers of weevils captured were usually noted as the nights progressed. These decreases showed a high positive correlation to decreases in the temperature. Samples in Western Oregon during the fall and spring indicated that overwintering adults lost their negative reaction to light. During this portion of the year temperature seemed to play the dominant role, the greatest numbers being captured at mid-day when the temperatures were near their highest

points. Samples taken in the spring in Eastern and Central Oregon indicated that Eastern Oregon weevils behaved in the same way as those in Western Oregon. Central Oregon weevils, though, showed a significant increase in the number captured after dark in the spring. It is hypothesized that this difference in activity may reflect a true biological difference rather than being just an artifact caused by climatic or other unknown factors. No significant difference between the activity of male and female weevils was demonstrated on any date at any location. Finally, although wind velocities were measured, no relationship between them and the numbers of weevils captured could be demonstrated. The probable explanation is the low wind velocities encountered during the course of this investigation.

The Diel Activity Cycle of the Adult Alfalfa Weevil, *Hypera postica* (Guill.), in Oregon

by

Roderick Ward Warner

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

June 1974

APPROVED:

Redacted for privacy

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Date thesis is presented 2/28/74

Typed by Opal Grossnicklaus for Roderick Ward Warner

ACKNOWLEDGEMENTS

This study was supported by the National Science Foundation through grant number GZ-1372, "Pest Population Ecology: An Inter-University Training Program."

I wish to give thanks to the following people for their assistance during this study:

My wife, Susan, for her patience and understanding during the many nights I was either away or kept odd hours while taking the data for this study.

To my major professor, Dr. P. O. Ritcher, for his encouragement, help, and constructive criticism.

To Dr. P. Oman for his constructive criticism.

To Dr. A. P. Appleby for helpful suggestions on data analysis and for constructive criticism.

To Dr. R. V. Frakes for his assistance on the statistical techniques used to analyze the data in this study.

To Dr. R. Van den Bosch of the Univ. of Calif. at Berkeley for helpful information on the Egyptian alfalfa weevil.

To the Dept. of Entomology at the Univ. of Calif. at Davis for the use of an alfalfa field.

To the Dept. of Crop Science at Ore. State Univ. for the use of an alfalfa field.

To the Mormon church of Corvallis, Oregon, for the use of an alfalfa field.

To M. Johnson for the use of facilities and an alfalfa field at the Central Oregon Experiment Station, Redmond.

To Dr. A. B. McArthur, for use of the Eastern Oregon Experiment Station, Union, alfalfa fields.

To R. G. Gates of Corvallis, Oregon, for use of an alfalfa field.

To Tom Bunch and Jim Burr, Central Oregon County Extension Agents, for help in finding suitable alfalfa fields.

To Roy Lindstrom, Prineville, Oregon, for use of an alfalfa field.

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THE DIEL ACTIVITY CYCLE OF THE ADULT ALFALFA WEEVIL, HYPERA POSTICA (GUILL.), IN OREGON

INTRODUCTION

The alfalfa weevil, Hypera postica, has been present in Oregon since 1919 and is now spread over most of the alfalfa producing areas of the state (Ritcher, 1972). Although figures as to the economic impact of this pest are not available, the value of alfalfa hay and seed in Oregon is over $30,000,000 annually (Ore. Commodity Data Sheet July 23, 1970); most of it grown east of the Cascade Range. If fields in this region are left untreated, severe damage is common (Ritcher, 1972). Thus this weevil is of great economic concern.

An understanding of the diel or 24 hour activity cycle of the adult alfalfa weevil could be a valuable tool in its management. Population dynamics studies are important in evaluating management techniques ranging from the use of chemicals to the release of parasites. If activity is cyclic, it is important for the investigator to be aware of this if he is to gain a true understanding of how a population changes through the application of some management technique. Also knowing what time of day the greatest number of adult weevils could be collected would be an aid to those interested in obtaining them for mass parasite rearing or cultures. Finally, a knowledge of when the weevils are active could be an aid in the use of short residual insecticides.

OBJECTIVES

The primary objective of this study was to determine if adult alfalfa weevils in Oregon have diel activity cycles. Secondary objectives included studying the influence of temperature, light intensity, wind velocity, weevil age, and weevil sex on these activity cycles in some of the major alfalfa growing regions of Oregon.

LITERATURE REVIEW

A review of the literature on the diel activity cycles of adult alfalfa weevils showed that further research on the subject was needed. Titus (1910) was the first to mention the possibility of a difference in activity at different times of day. He stated that in Utah the majority of the adult weevils fed from nine P. M. to one A. M. and at dawn. Parks (1913) stated that in Idaho the greatest number of adult weevils were found feeding from six P. M. to one A. M. Reeves (1927), generalizing on the activity of the weevils throughout their range, stated that from the time of the second cutting until the cool weather of September begins, their activity was greater at night than during the day. Sweetman (1929) found that the adult weevils in Wyoming became active when the temperature reached 10° to 12° C. He observed no effects of moisture or light and found that air movements seemed to affect the beetles only in a mechanical way. He also stated that wind velocities above the plants must exceed 25 m. p. h. to greatly disturb the insects on the plants. Sweetman (1932) made observations of the night activities of the weevils in a Wyoming field during warm nights in the middle of June. He found that movement, feeding and mating continued as during daylight hours when the temperature was high enough. Michelbacher (1943) found that adult alfalfa weevils in California were apparently most

active at temperatures of about 70° to 75° F. He further went on to indicate a wind effect when he stated that on "still days" the weevils may crawl up the plants in large numbers.

Of the more recent workers on alfalfa weevils, Poinar and Gyrisco (1960) observed much greater activity at night than in the daytime in New York. After careful field studies, they concluded that light rather than temperature or relative humidity was mainly responsible for this type of diel activity. The same workers (Poinar and Gyrisco, 1964) reported on laboratory experiments in which alfalfa weevil adults were subjected to various durations and intensities of artificial light. They found that the adult activity cycle was of the exogenous type, that the majority of weevils were sensitive to light intensities as low as four foot candles, and finally that the light reaction could be modified since starved weevils were much less sensitive to light than normal ones. Bass (1967) took 20-sweep collections once each hour during one day of every month. He found that adult alfalfa weevils were most active at night throughout the year in Alabama. Southwick and Davis (1968) concluded that during the summer months in Utah new-generation adults, and to a lesser extent overwintered adults, are most active during darkness. In spring though, when only overwintered adults are present, light intensity seems to have little effect on adult activity with temperature being the main governing factor.

It should be noted that only the papers by Poinar and Gyrisco and the one by Southwick and Davis actually presented graphical analysis of their data relating to the diel activity cycles of adult alfalfa weevils. It should be further noted that Poinar and Gyrisco were the only authors to subject their data to statistical analysis.

The experiments by Poinar and Gyrisco seemed to indicate conclusively that the diel activity cycle of adult alfalfa weevils in New York State during the month of July is regulated by light intensity. They have not demonstrated what is happening in the fall or spring nor do their experiments rule out the possibility that the Western or Egyptian biotypes of the weevil might react differently. As has already been shown, other authors have mentioned the importance of temperature and at least two indicate that wind might have an effect. Bass claimed that the weevils are more active at night throughout the year while Southwick and Davis presented data which indicated there is a difference in the activity of overwintered and new-generation weevils. Thus the need for further study is apparent.

MATERIALS AND METHODS

Experiments to study the diel activity cycle of adult alfalfa weevils in Oregon were carried out in Western Oregon near Corvallis, Central Oregon near Redmond and Prineville, and Eastern Oregon at Union. Table 1 gives the region, location, and date of each experiment.

A randomized complete block design was used in each experiment. The experimental field was first divided into four blocks. Each block was then subdivided into 12 plots. At predetermined times one plot from each block was sampled. The plots to be sampled at a given time were determined beforehand by using a table of random numbers.

A standard sample consisted of 25 180° sweeps with a 15 inch diameter sweep net. The sampling order was always block A first, block B second, block C third, and block D fourth. The time necessary to sample all four blocks varied from 10 minutes when it was light and the field was dry to 20 minutes at night when heavy dew was present.

Immediately prior to the sampling, the air temperature, wind velocity, and light intensity were measured. The air temperature was taken at the edge of the field at a height of approximately three feet above the ground with a centigrade thermometer. A Dwyer®

Table 1. Locations and dates of experiments.

Region	Location	Date
West. Ore.	1 mi. E. of Corvallis	Aug. 24-25, 1972
West. Ore.	1 mi. E. of Corvallis	Sept. 28-29, 1972
West. Ore.	1 mi. E. of Corvallis	Oct. 11-12, 1972
West. Ore.	1 mi. E. of Corvallis	Nov. 10, 1972
West. Ore.	6 mi. N. of Corvallis	April 4-5, 1973
West. Ore.	6 mi. N. of Corvallis	May 2-3, 1973
Cent. Ore.	Redmond Expt. Station	May 16-17, 1973
East. Ore.	Union Expt. Station	June 6-7, 1973
West. Ore.	4 mi. S. E. of Corvallis	June 20-21, 1973
East. Ore.	Union Expt. Station	July 12-13, 1973
Cent. Ore.	2 mi. N. of Prineville	July 24-25, 1973
West. Ore.	4 mi. S. E. of Corvallis	Aug. 1-2, 1973

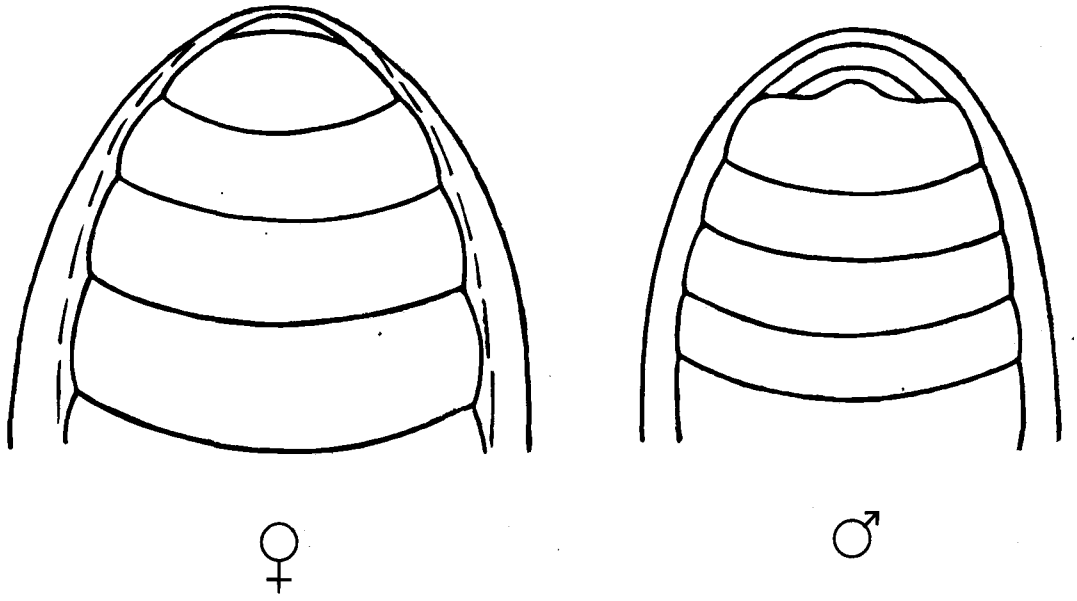

Figure 1. Ventral views of the abdomens of male and female adult alfalfa weevils (After Ritcher, 1972).

wind meter was hand held at an approximate height of four feet and an estimate of the average and maximum wind speeds was made. A General Electric® model number 8DW40Y16 light meter was used to measure the light intensity. The readings from this instrument were taken at height of approximately four feet with the sensitive portion pointed vertically.

The average height of the alfalfa in each block was estimated by randomly measuring ten plants and then taking the mean. Since this factor was constant during each experiment, no attempt was made to correlate weevil activity to it. These values are given in Appendix Table 1.

Immediately after each 25 sweep sample, the contents of the net were carefully emptied into a plastic bag and labelled as to time, block, and plot number. These samples were later sorted by placing the chilled contents into a white tray and picking out the adults with forceps.

The adults were examined under the low power of a stereo microscope to determine their age and sex. Males and females were separated quite easily by the shape of the last abdominal segment (Figure 1). There was no difficulty determining the age during the late summer and fall of 1972 because only new generation weevils were captured. During the spring of 1973, all of the adults were assumed to have overwintered until new generation larvae began to

pupate in mid-June. From that point on, overwintered adults were assumed to be those which appeared darker (Southwick and Davis, 1968). This darkness was due to both increased sclerotization and a loss of scales. The assumption that the darker individuals were of the older generation was borne out by dissections in early summer which showed fully developed eggs in most of the dark females and no egg development in the light colored ones. That the light colored individuals were of the new generation was further shown in that many were still teneral in late June and early July.

Experiments were conducted in three of Oregon's major alfalfa growing regions in order to gain additional understanding of the activity cycles of the adult weevils in the state as a whole. Western Oregon was studied the most extensively with early results indicating that two patterns of diel activity were exhibited. One occurred in the fall and spring, the other in the summer. On this basis it was decided that one experiment in the spring and one in the summer in both Central and Eastern Oregon would be sufficient to determine if the same two patterns occurred in those regions.

Samples were not taken in Oregon between November, 1972 and April, 1973, because the above ground parts of the alfalfa were either dead or too short to sweep.

In March 1973 however, an experiment was conducted at Davis, California, where the Egyptian alfalfa weevil occurs. These results

are given in Appendix Tables 2-4.

There were several reasons why a randomized complete block design was used. First, this was the design used by Poinar and Gyrisco (1960). Second, more precision can be obtained because much of the error caused by heterogeneous weevil distribution can be eliminated (Steel and Torrie, 1960). Third, the statistical analysis of the data is simple and it will not be complicated if, as a result of mishap, the data from a complete block or certain treatments are unusable (Steel and Torrie, 1960).

The sweep net was chosen as the sampling method for several reasons. First, this was the method used by most earlier workers. Second, Blickenstaff and Huggans (1969) compared the four most common sampling methods and found that all were equally effective when relative numbers were desired. They further concluded that since sweeping is the quickest, easiest, and simplest method, it is the method of choice. Finally, sweep nets are readily available to other workers who may wish to put the findings of this study to use.

A single temperature measurement, instead of one per block, was used in order to shorten the sampling time. This was justified because temperatures in the various blocks of an alfalfa field were quite uniform (Appendix Table 5). There is a possibility that in some cases the temperature the weevils experienced may have been higher than the air temperature because of radiation absorption.

If this was true, a combination of air temperature and black-globe temperature readings might have given a somewhat better explanation of the results.

During the first three experiments, quantitative measurements of light intensity were not taken. The time of sunrise and sunset was noted since this gave a good indication of which samples were taken in the dark and which in the light. This was assumed to be of value because Poinar and Gyrisco (1960 and 1964) had indicated that the weevil light reaction was characterized by an "all-or-nothing" response. For dates when quantitative measurements were available, values of five foot candles or greater were defined as "light" while those of less than five foot candles were defined as "dark." These definitions are in accord with the findings of Poiner and Gyrisco (1964) that alfalfa weevils will not react to light intensities of four foot candles or less.

In some cases, particularly during sunrise, a fair amount of light intensity change occurred during the 15 to 20 minute sampling time. When this happened, an average value between the light intensities before and after sampling was used. Since a constant light intensity over all blocks during a given sampling time was desired, taking a separate reading at each block would have only slowed down the sampling process, increased the amount of variation, and complicated the analysis.

The effects of wind on adult alfalfa weevil activity were not adequately studied for several reasons. Since a small hand-held wind gauge was used, the velocity of the wind was only measured over a very short time. A truer idea of the maximum and average wind velocities would have been gained by the use of some sort of continuously recording device. Unfortunately, such a device was not available. An even more serious difficulty was that in all but two cases the amount of wind present was negligible. Even in these two cases the velocities were well below the 25 miles per hour mentioned by Sweetman (1929) as being necessary to disturb the weevils.

The sorting and identification techniques should not have constituted a major source of error. Of the over 7,000 adults handled, only about ten were found to have crawled outside the tray. If an equal number are assumed to have escaped completely, this is still much less than one percent of the total. The identification of the age and sex of the weevils presented no difficulties.

RESULTS

The results obtained during the course of this study are presented in five sections. The first three sections give the results of experiments designed to investigate the relationship between temperature, light intensity, and the time of day and adult weevil activity in Western, Eastern, and Central Oregon. The fourth section gives the results of experiments which attempted to relate wind velocity and adult activity. The final section is a summary which gives an overview of the results discussed in the other four sections.

Western Oregon

Of the 12 experiments carried out in Oregon during the course of this investigation, eight were undertaken in the western part of the state. This averages out to one experiment per month during the period between April and November when adult alfalfa weevils are active. For this reason the most complete results on how adult activity cycles varied during the year came from Western Oregon.

The results of experiments conducted Aug. 1-2, 1973 and Aug. 24-25, 1972 give an indication of how Western Oregon weevils behave from mid to late summer when almost all of the adults present are of the new generation. It was found that there was a very sharp increase in the number captured after dark but as the night progressed

the number captured decreased (Figures 2 and 3). The simple correlation coefficients relating weevil numbers to the temperature after dark are quite high (Appendix Tables 13 and 19) indicating that this decrease in numbers is related to the decrease in temperature which generally occurs at night during this time of year in Western Oregon. Statistical analysis of the data showed that both the increase in numbers after dark and the decrease in numbers as the night progressed were significant and that the behavior of male and female adults did not differ significantly during this season in Western Oregon (Appendix Tables 6-19).

The data obtained on September 28-29, 1972, seems to indicate that a transitional type of behavior may occur in the last few weeks of summer and the early weeks of fall. As with the data from August 1972 and 1973, there were significantly more adults captured at night than during the day (Figure 4 and Appendix Tables 21 and 22). The degree of this significance though, was much less. For example on September 28-29 between 14 and 30 percent as many adults were captured during the day as during the peak in "activity" at night (Appendix Table 21). In contrast, on August 1-2, 1973, only between zero and two percent as many were captured during the day as at the night peak (Appendix Table 7). Also no meaningful correlation between weevil numbers and temperature could be found at any time during the experiment on September 28-29 (Appendix Table 23). This again

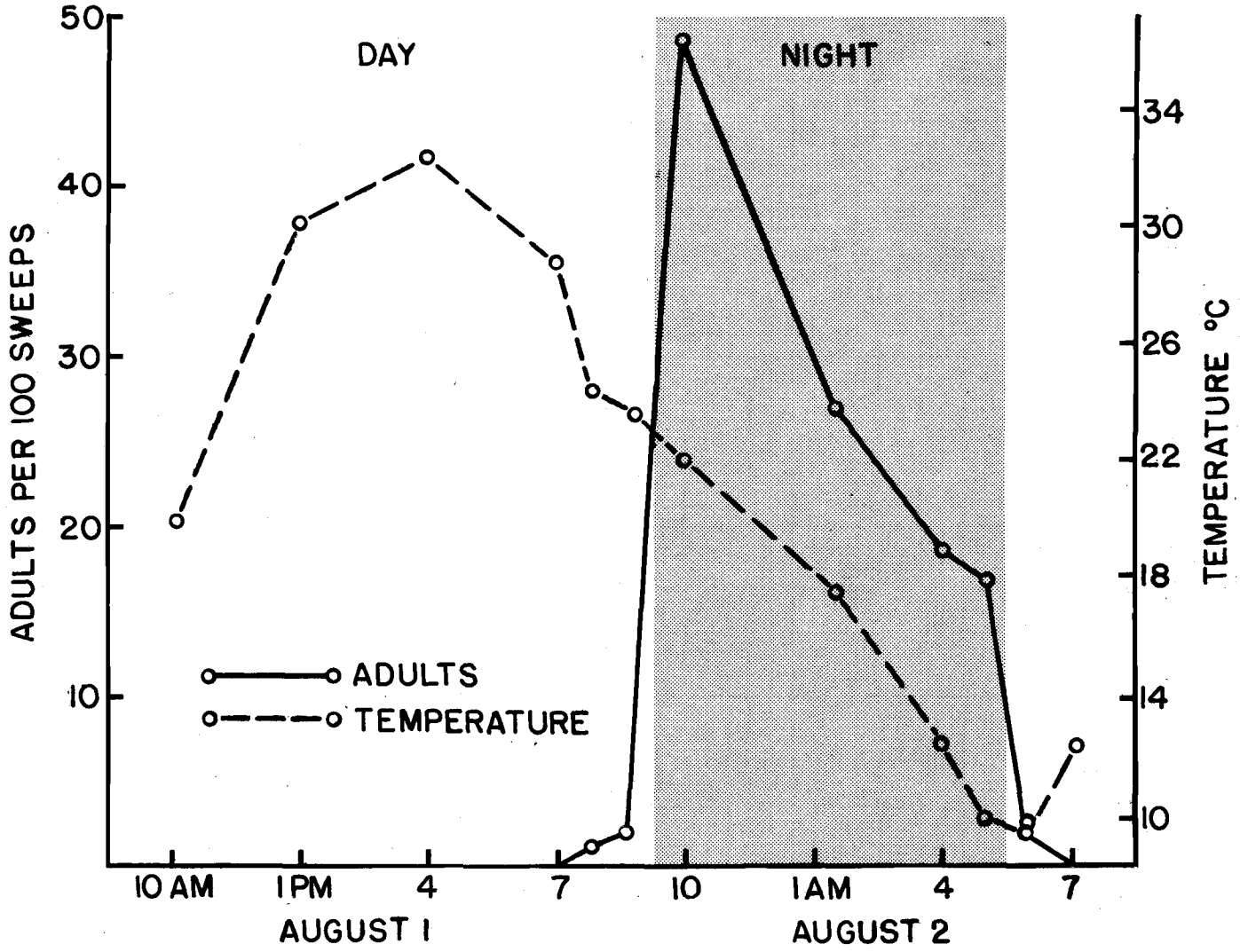

Figure 2. Number of new generation adult weevils and temperature at different sampling times four miles southeast of Corvallis, August 1-2, 1973.

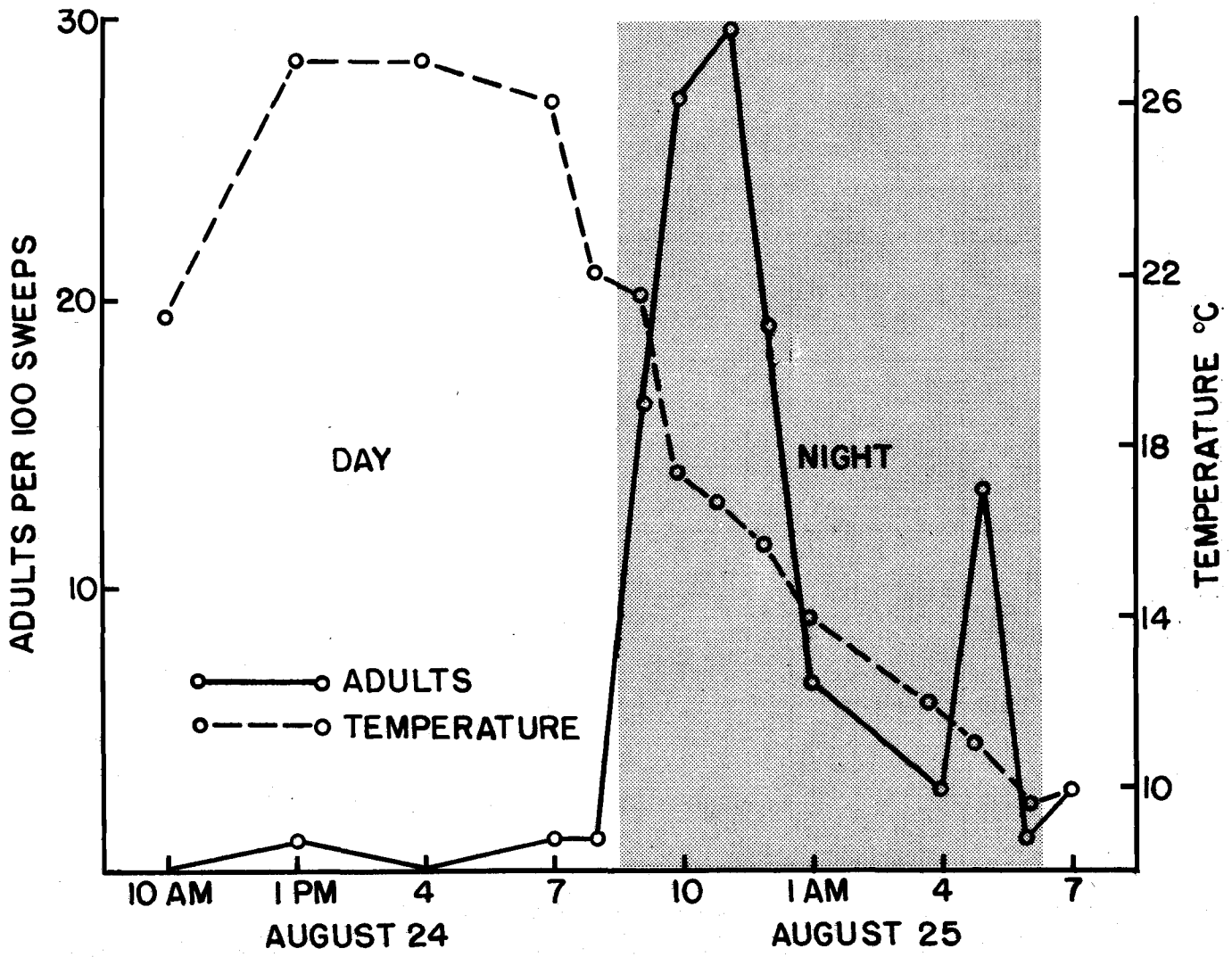

Figure 3. Number of adult weevils and temperature at different sampling times one mile east of Corvallis, August 24-25, 1972.

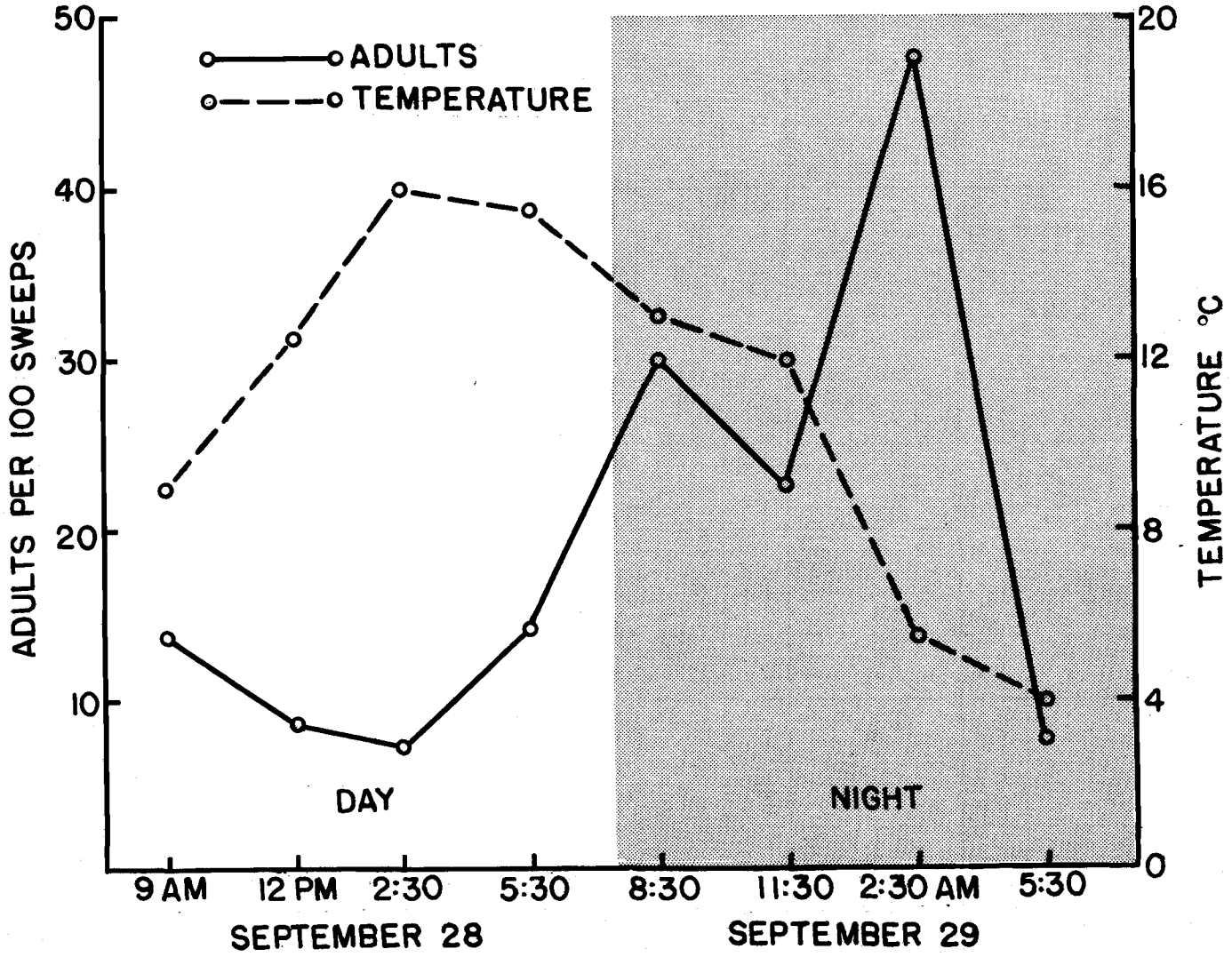

Figure 4. Number of adult weevils and temperature at different sampling times one mile east of Corvallis, September 28-29, 1972.

contrasts with the August data where there was a high correlation between the numbers of weevils captured and the temperature after dark.

Overwintering adult weevils from October 1972 through May 1973 exhibited a considerably different activity pattern than that observed with new generation weevils in mid to late summer. Instead of demonstrating a peak in activity after dark, the greatest numbers were captured at mid-day, usually at a time coinciding with the greatest temperature (Figures 5-8). In three of the four experiments conducted in Western Oregon during this period, the temperature ranges were less than 10° C (Appendix Tables 24, 34, and 54). In each of these cases the only significant differences in the numbers of weevils captured were between the highest and lowest values (Appendix Tables 25, 35, and 55). The experiment conducted on April 4-5, 1973, differed from the others of this period in that there were greater numbers of weevils captured and a larger temperature range (Appendix Table 44). These factors allowed a statistically more accurate analysis of the influence of light intensity and temperature on the number of weevils captured. The correlation coefficients relating the temperature to the number of adults were high for all segments of the day indicating that temperature was the major factor regulating weevil activity (Appendix Table 51). Light intensity also showed a fairly high positive correlation with weevil numbers on this date.

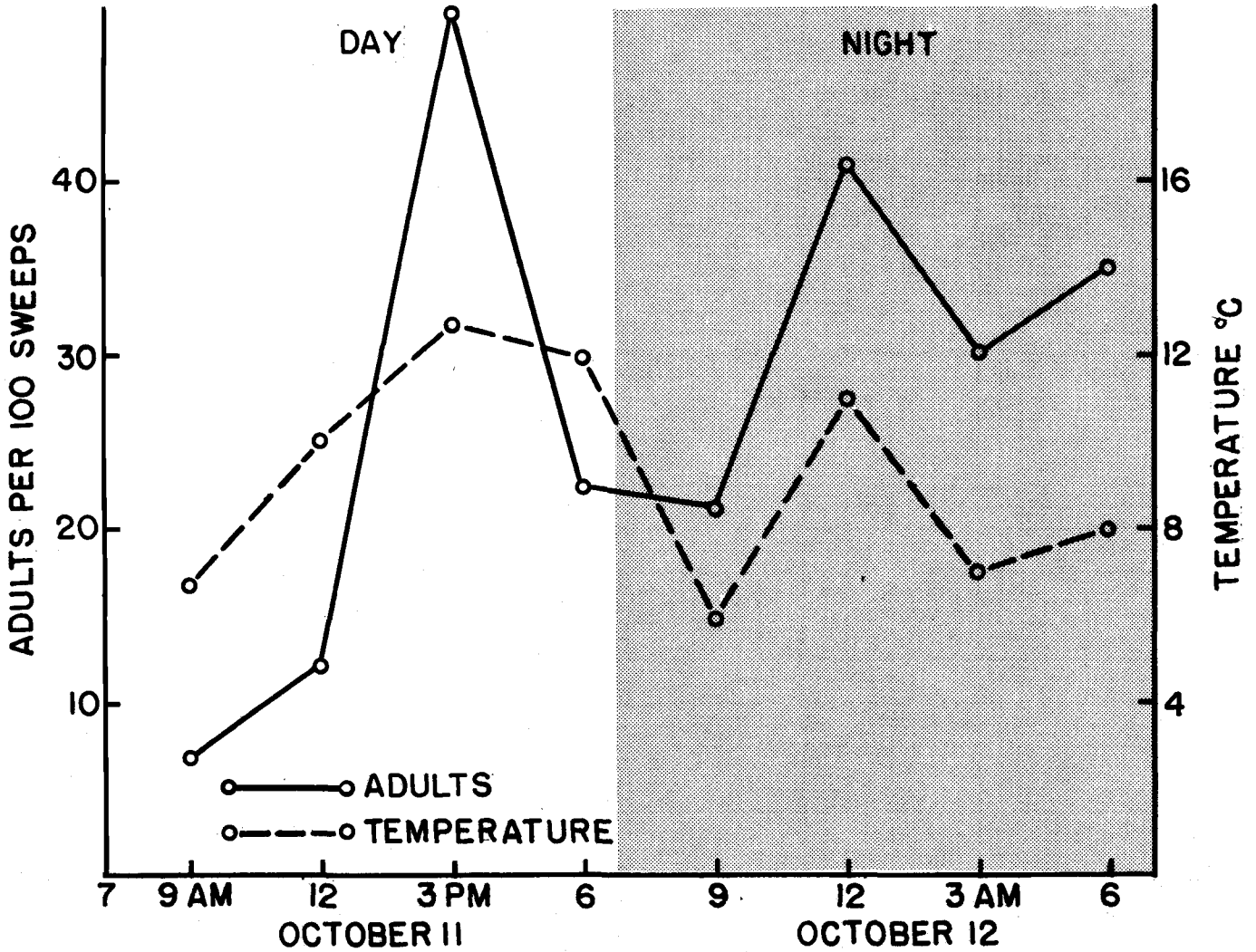

Figure 5. Number of adult weevils and temperature at different sampling times one mile east of Corvallis, October 11-12, 1972.

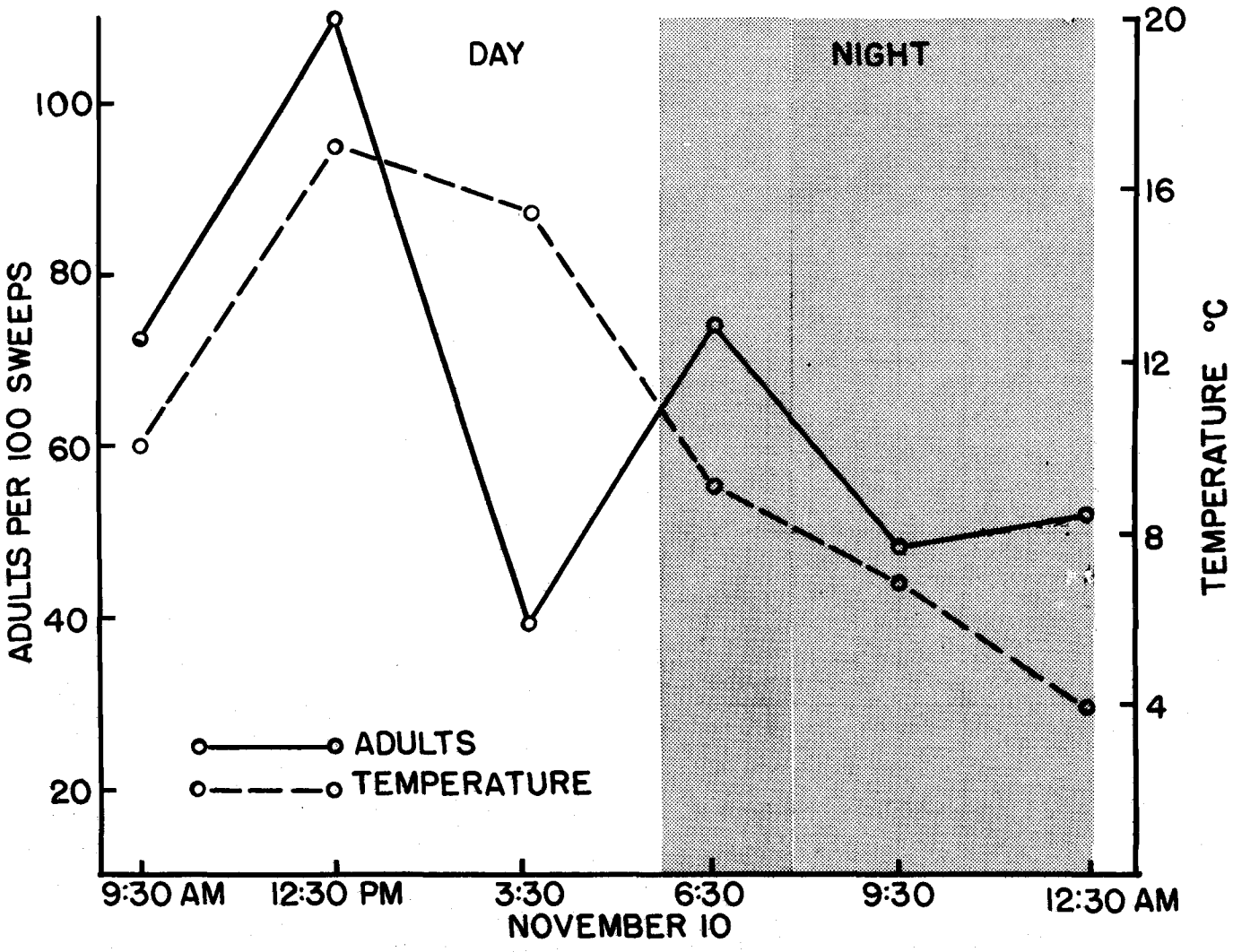

Figure 6. Number of adult weevils and temperature at different sampling times one mile east of Corvallis, November 10, 1972.

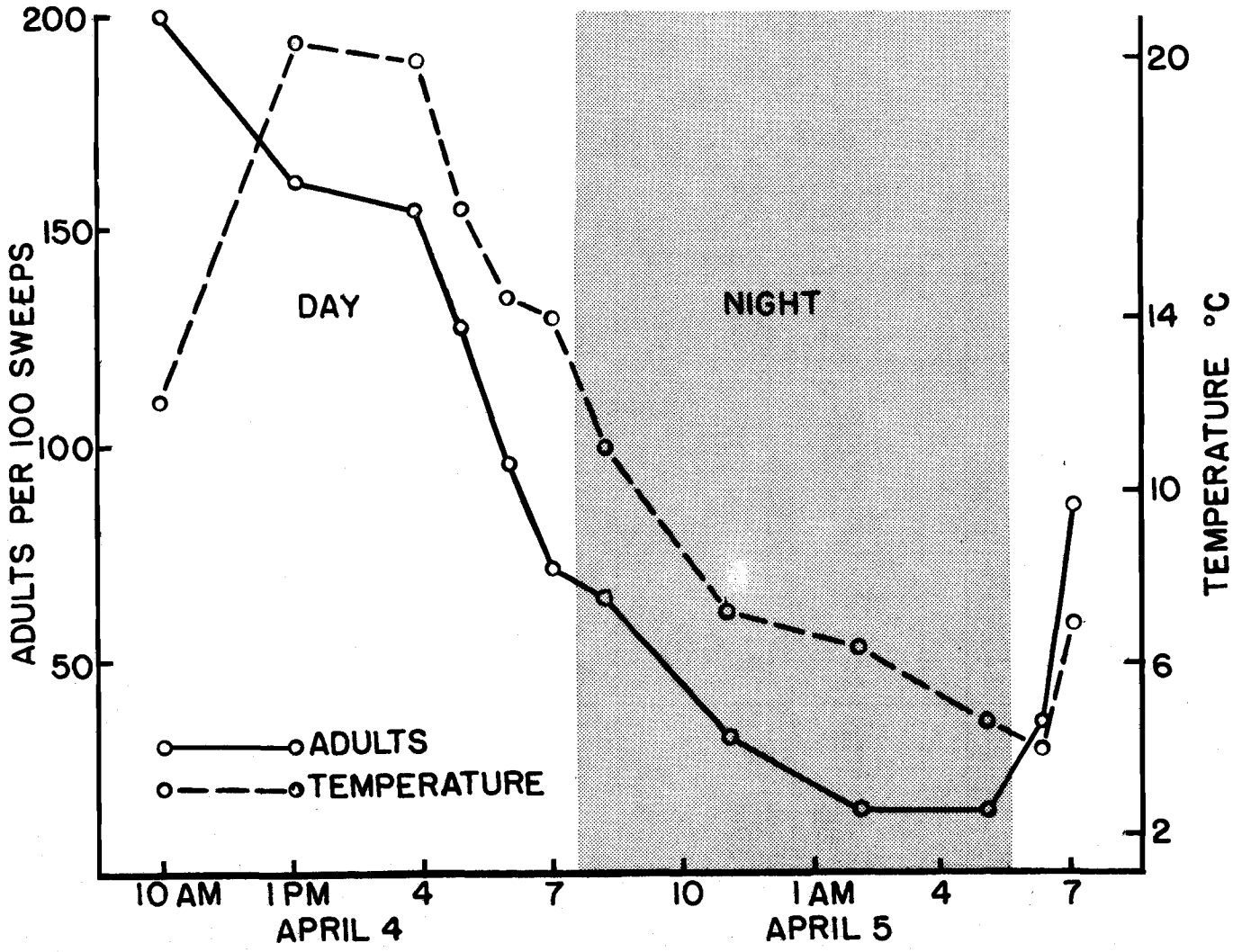

Figure 7. Number of adult weevils and temperature at different sampling times six miles north of Corvallis, April 4-5, 1973.

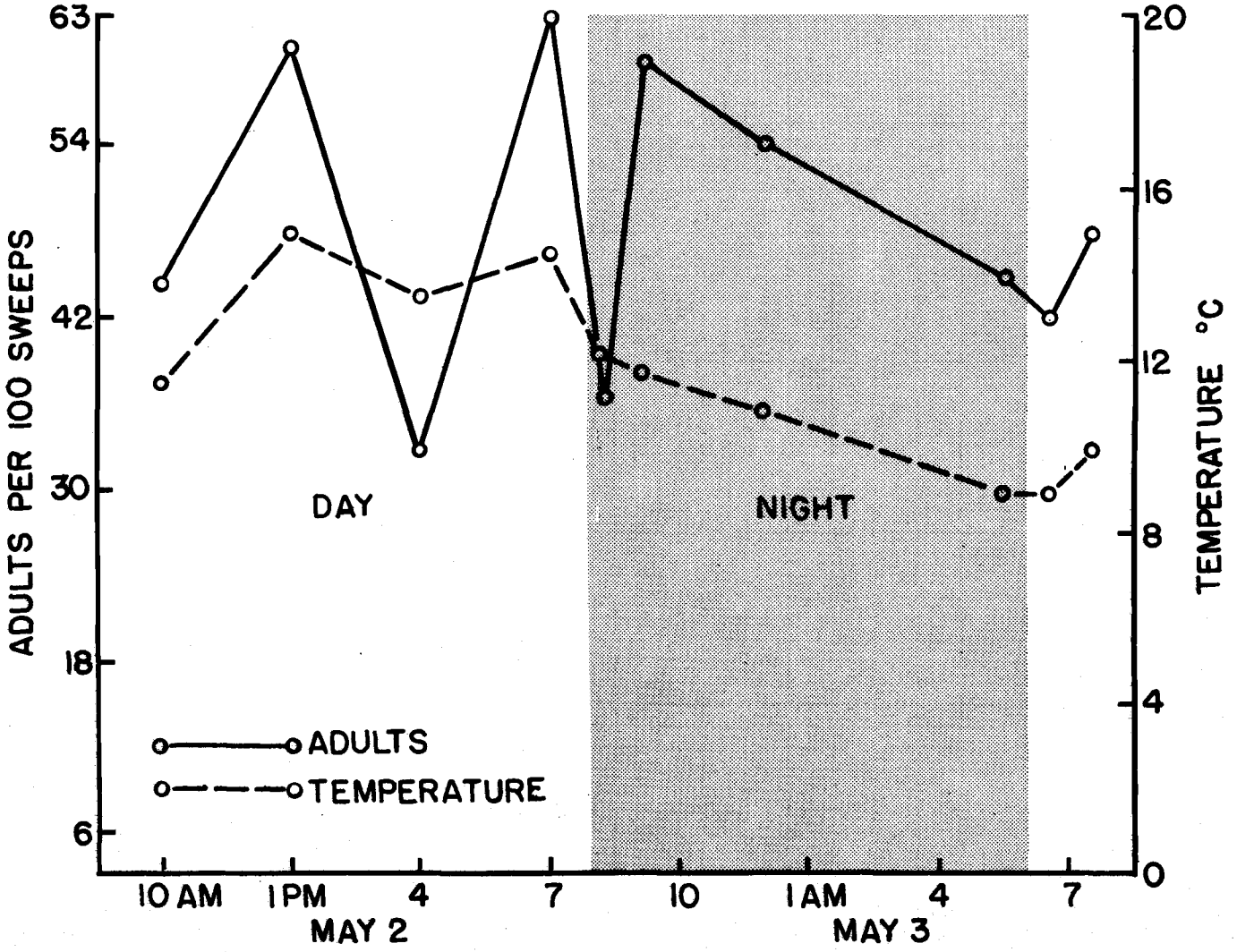

Figure 8. Number of adult weevils and temperature at different sampling times six miles north of Corvallis, May 2-3, 1973.

This probably reflects the fact that the higher light intensities coincided with the higher temperatures. For all dates of the fall and spring, statistical analysis shows that the activity of males and females did not differ significantly (Appendix Tables 24-63).

Data taken on June 20-21, 1973 gave a good indication of how new generation adult weevils reacted early in the summer. Although there was definitely a negative light reaction, it differed from that of mid to late summer in that a significant increase in the number captured occurred before the light intensity fell below five foot candles (Figure 9 and Appendix Tables 64 and 66). This indicates that weevil activity is controlled by light intensity in an inverse linear fashion early in the summer but changes to an "all-or-none" response in mid to late summer. This inverse linear response to light intensity is confirmed by the large negative value obtained for the correlation coefficient relating weevil numbers to light intensity (Appendix Table 75). No significant difference in the activity of new generation males and females was observed on this date (Appendix Tables 67, 68, 72, 73, 76, and 77).

The June 20-21, 1973 data were a poor indication of how overwintered adults react to light and temperature during the early summer because the numbers captured were too small to be statistically accurate (Appendix Tables 64 and 74).

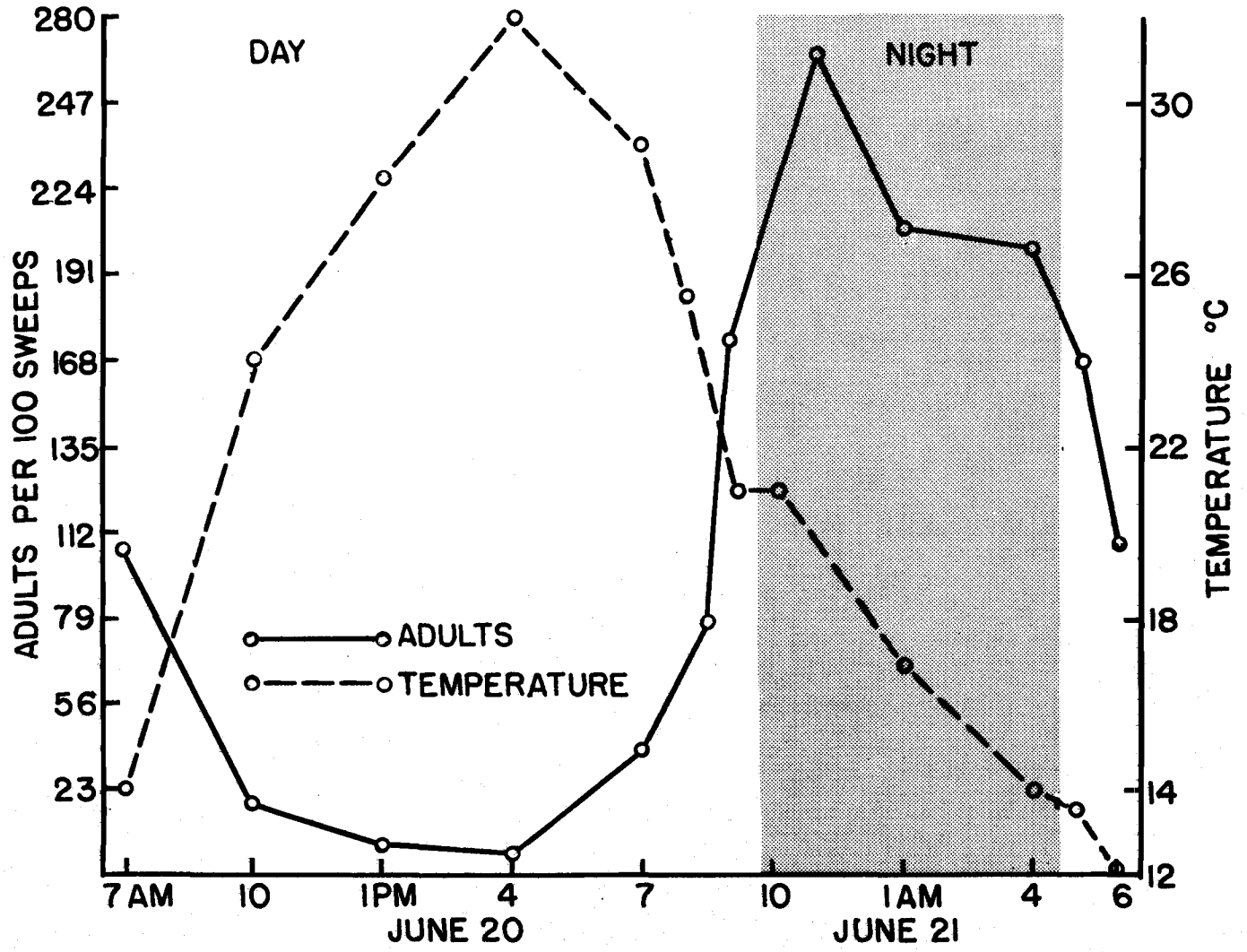

Figure 9. Number of new generation adults and temperature at different sampling times four miles southeast of Corvallis, June 20-21, 1973.

Eastern Oregon

The results from Western Oregon indicated that two general patterns of alfalfa weevil activity existed in that region; a strong negative reaction to light with the new generation weevils in the summer, and a probable temperature dependent type of activity with the overwintering weevils in the fall and spring. To see if this general pattern held in Eastern Oregon, one experiment was conducted in the spring on June 6-7, 1973 and another was conducted during the summer on July 12-13, 1973. Both of these experiments were carried out at the Eastern Oregon Experiment Station at Union, Oregon.

During the first experiment on June 6-7, only overwintered adults were captured, and the net results were a peak in activity occurring at mid-day (along with the higher temperatures) but in general no really meaningful differences in activity during the experiment as a whole (Figure 10 and Appendix Table 80). One difference between this pattern and those in Western Oregon which showed similar results (experiments conducted in Oct. and Nov., 1972, and May, 1973) was that larger numbers of weevils were captured and there was a somewhat greater temperature range (13° C compared to 10° C or less). Thus a more clear relationship between weevil activity and temperature, such as that found on April 4-5, 1973, in Western Oregon, might have been expected. That it was not might be explained by the greater

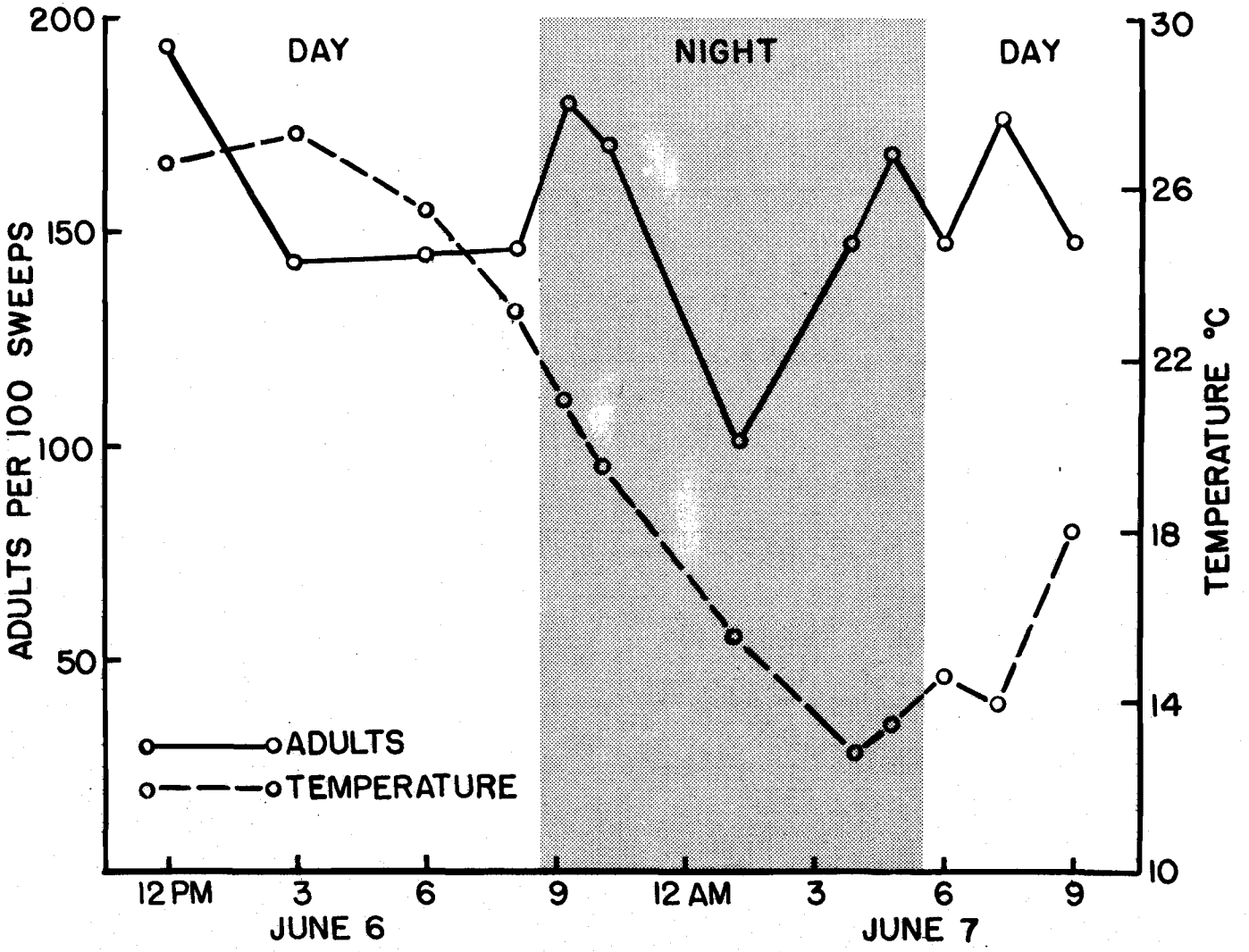

Figure 10. Number of adults and temperature at different sampling times, Union Experiment Station, June 6-7, 1973.

variation between blocks on June 6-7 (compare Appendix Tables 48 and 83). Another possible explanation might be that some real biological difference in the behavior pattern of overwintering Western and Eastern Oregon weevils exists during the spring. The experiment did show conclusively, though, that Eastern Oregon weevils were similar to those in Western Oregon in that no negative light reaction existed in the spring, and that there was no difference in the behavior of males and females in that season (Appendix Tables 79-88).

The influence of light intensity and temperature on the number of new generation weevils captured on July 12-13, 1973, in Eastern Oregon appeared to be very close to that on Western Oregon weevils captured on June 20-21, 1973. Again there was a strong negative light reaction with significant increases in numbers with decreasing light intensity (Figure 11 and Appendix Tables 89 and 91). The relationship to light appeared to be an inverse linear one because a large negative correlation coefficient was obtained (Appendix Table 105) and there was a significant increase in numbers before the light intensity fell below five foot candles (Appendix Tables 89 and 91).

The July 12-13 experiment had large enough numbers of overwintered adults to allow for a meaningful analysis. The net result was that from early evening to early morning there were significantly more overwintered weevils captured than from 9:00 AM to 6:00 PM (Pacific Daylight Time) (Figure 11 and Appendix Table 94). As with

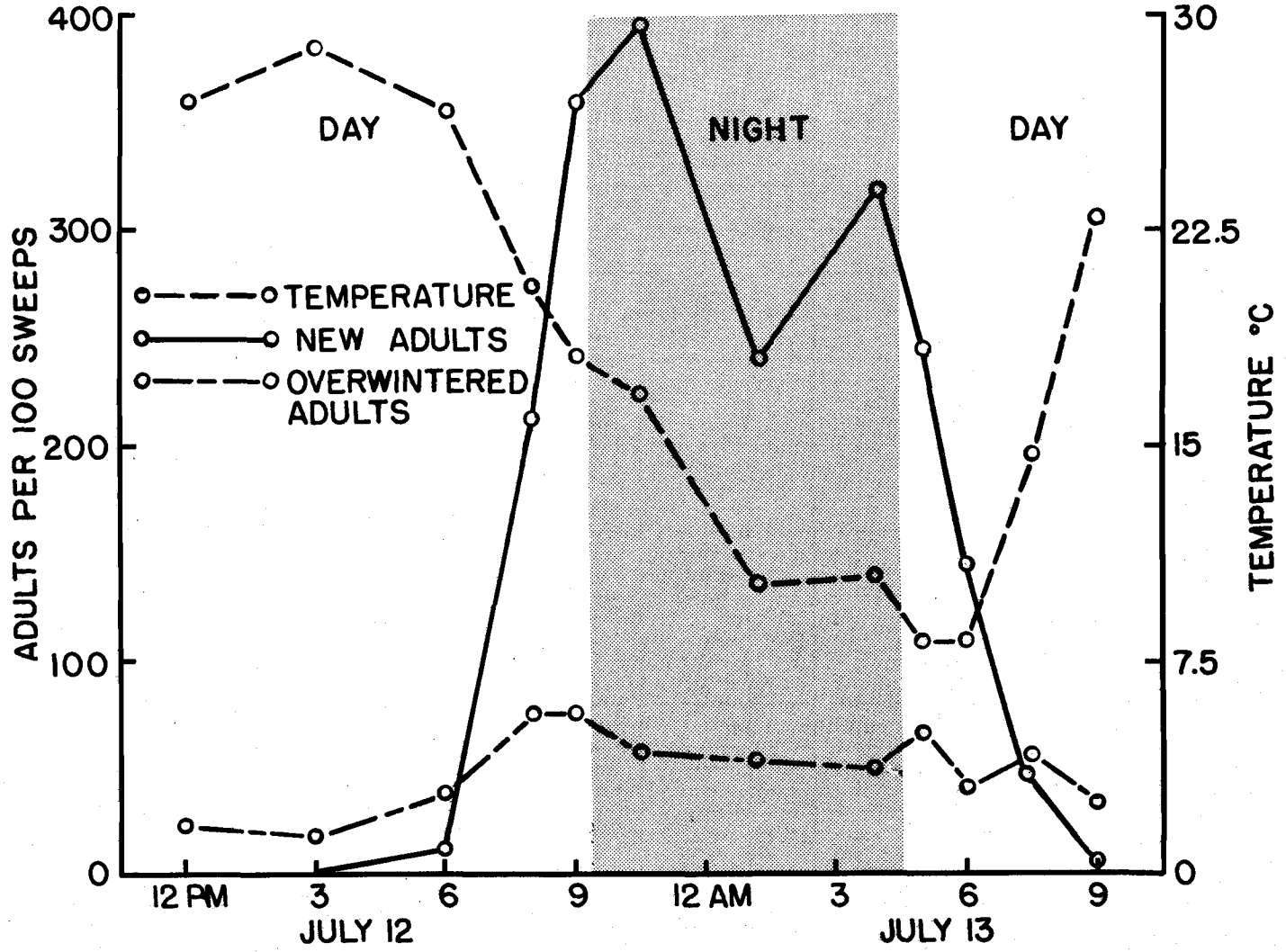

Figure 11. Number of adults and temperature at different sampling times, Union Experiment Station, July 12-13, 1973.

the new generation adults, a negative linear relationship between light intensity and weevil numbers was found (Appendix Tables 89, 94, and 108). No meaningful relationship between the numbers of overwintered weevils and the temperature could be established during any portion of the day (Appendix Tables 89, 94, and 108).

No significant differences in the activity cycles of either overwintered or new generation males and females could be found on July 12-13, 1973, in Eastern Oregon (Appendix Tables 89-110). Interestingly, though, there were considerably more overwintered females than males captured on that date (Appendix Tables 95 and 96).

Central Oregon

Two experiments were carried out in Central Oregon to see if the general pattern of a strong negative reaction to light with new generation weevils in the summer and a complete lack of this reaction in the fall and spring held for this region as well as Western and Eastern Oregon. The first experiment was carried out on May 16-17, 1973 at the Central Oregon Experiment Station in Redmond. The second experiment was conducted in a privately owned alfalfa field two miles north of Prineville on July 24-25, 1973.

On May 16-17, only overwintered adults were captured, and the net results showed an activity pattern quite similar to that found in Western Oregon from mid to late summer in that significantly more

weevils were captured after dark than during the day (Figure 12 and Appendix Table 112). The results are also similar in that the negative reaction to light was an "all-or-none" response rather than a linear one (Appendix Tables 111 and 118). As with most other locations and seasons, a fairly high correlation coefficient relating weevil numbers to temperature during the night was found (Appendix Table 118), and no significant difference in the activity cycles of males and females was noted (Appendix Tables 111-120).

The results of the experiment carried out on July 24-25, 1973 (Figure 13) were very similar to those of mid to late summer in the Western Oregon region. A meaningful analysis could only be made for new generation weevils since the number of overwintered weevils was too small to be significant (Appendix Tables 126 and 131). With the new generation individuals, the correlation coefficient relating weevil numbers to light intensity was not high enough to indicate that a linear relationship existed (Appendix Table 132). No significant difference between the behavior of new generation males and females was detected on July 24-25 (Appendix Tables 121-134).

Wind Velocity

Wind velocities were only high enough twice to warrant an analysis of the relationship between this factor and the number of weevils captured. The two experiments where this occurred were

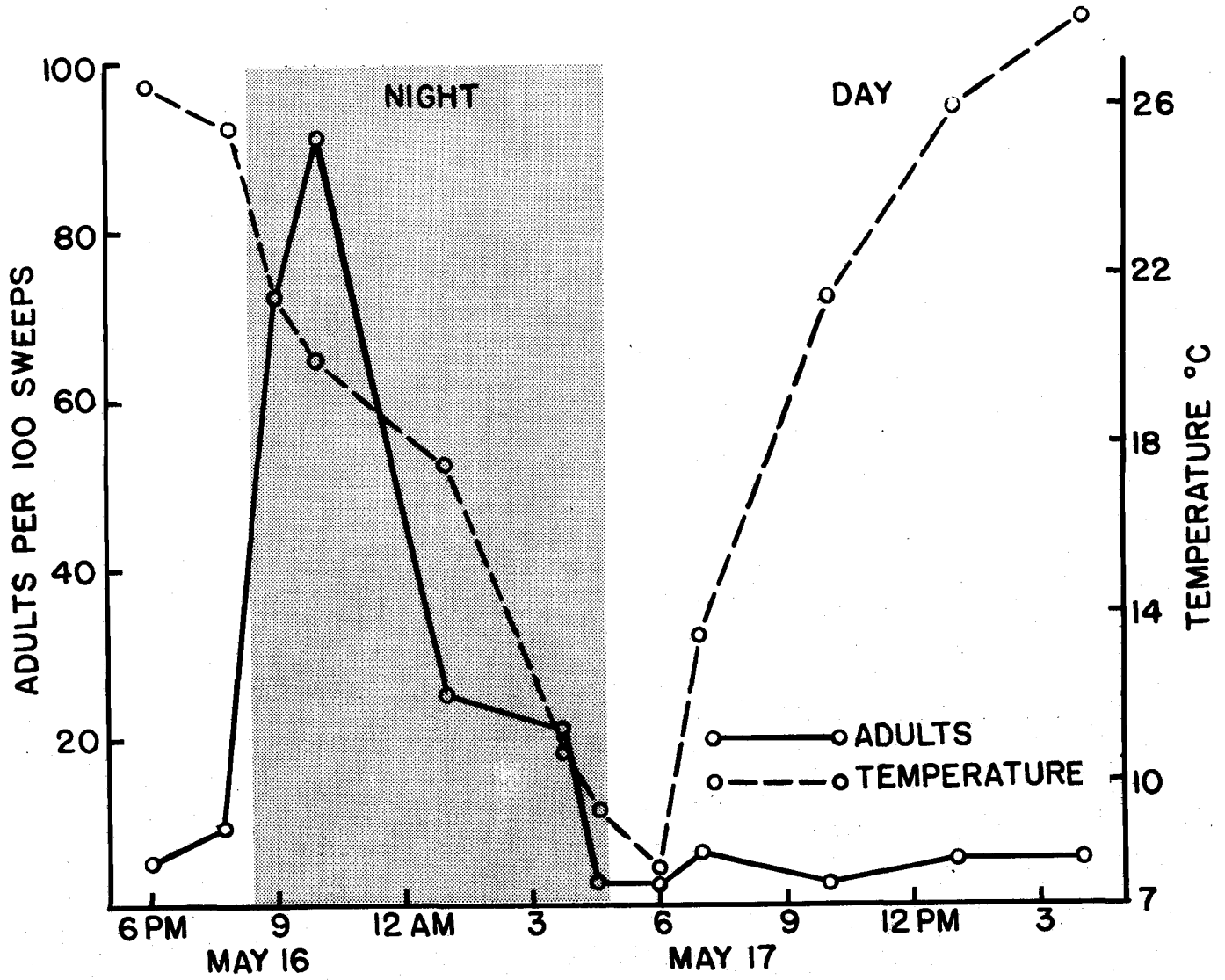

Figure 12. Number of adults and temperature at different sampling times, Redmond Experiment Station, May 16-17, 1973.

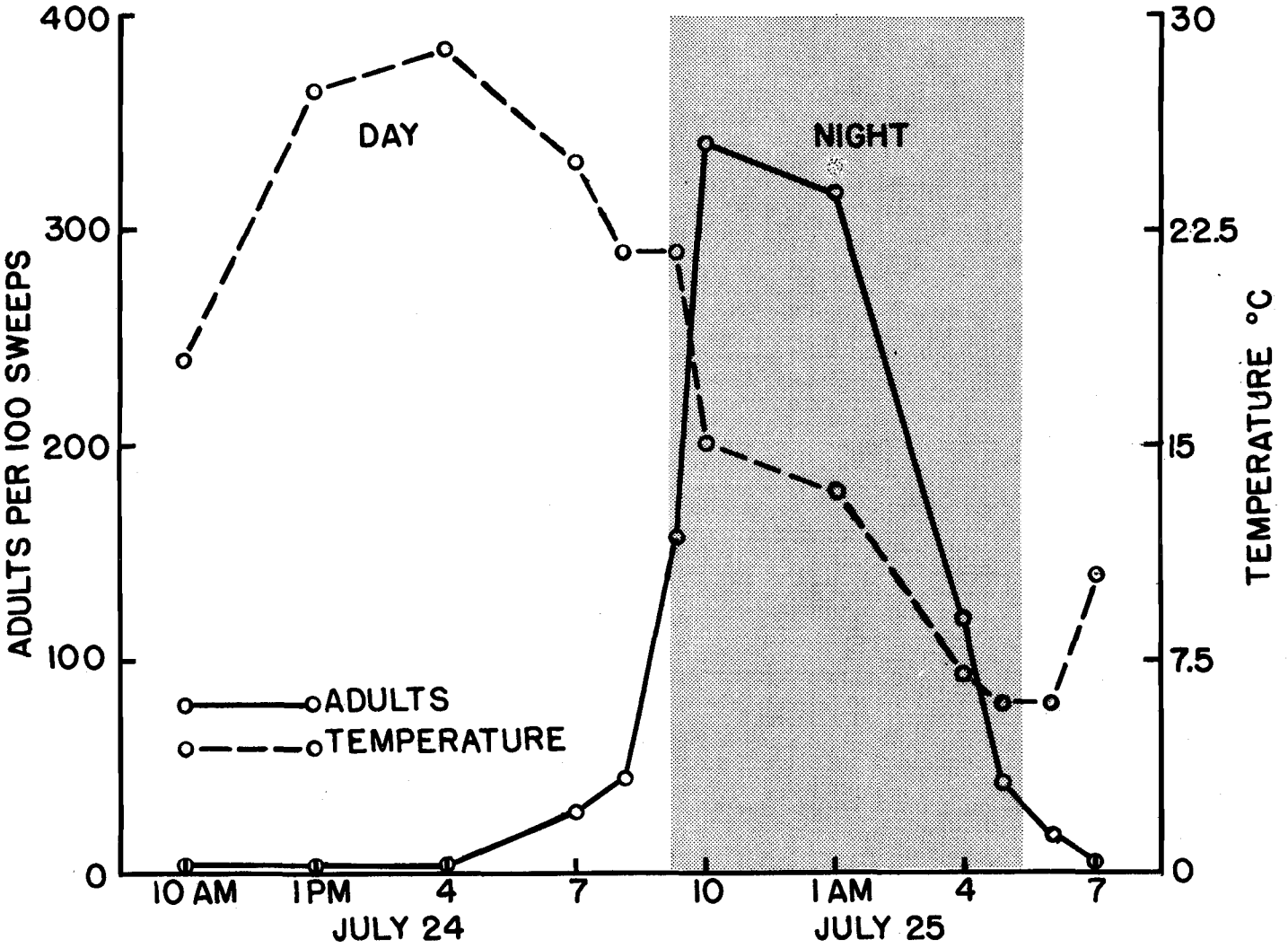

Figure 13. Number of new generation adults and temperature at different sampling times two miles north of Prineville, July 24-25, 1973.

both in Eastern Oregon. On June 6-7, both the raw data (Appendix Table 136) and the low correlation coefficients (Appendix Table 138) show quite clearly that there was no relationship between the number of weevils captured and the wind velocity on this date. On July 12-13 the raw data (Appendix Table 137) and the moderate correlation coefficients (Appendix Table 138) indicate that there might be some sort of negative relationship between the velocity of the wind and the number of weevils captured. A much more likely explanation though, is that this "relationship" is just an artifact which reflects the fact that the higher wind velocities occurred at the same time as the higher light intensities (compare Appendix Tables 89 and 137). This explanation is further substantiated by the fact that similar results were obtained when the wind velocity was negligible throughout the experiment (compare Figures 9 and 11).

Summary

Adult alfalfa weevils exhibited diel activity cycles in all parts of Oregon studied. In general, the weevils in Western and Eastern Oregon responded in the same way to light and temperature. In the summer, light was the dominant factor with very little weevil activity occurring during the daytime. After dark though, there was a close positive relationship between weevil activity and temperature. During the fall and spring, temperature appeared to be the dominant factor

and the negative light reaction no longer occurred. Light was the dominant physical factor controlling weevil activity in Central Oregon in both the spring and the summer. As with the Western and Eastern Oregon weevils, a close positive relationship between temperature and weevil activity existed in both seasons after dark. These results are summarized in Table 2 along with information from other regions as found in the literature.

These experiments showed conclusively that no significant differences in the diel activity cycles of male and female weevils exist in any of the areas in Oregon which were studied.

These experiments did not demonstrate any relationship between wind velocity and alfalfa weevil activity. This does not mean that none exists but rather it reflects the lack of sufficient wind velocities during the experiments.

A convenient way to summarize the relationship between weevil numbers and a physical factor such as temperature or light intensity is through the use of a simple correlation coefficient (R). Tables 3, 4, and 5 give correlation coefficients for the different age and sex groups from Western, Eastern, and Central Oregon. Table 5 also includes data on the Egyptian alfalfa weevil from California for comparison. In all cases one of the variables (Y) was the number of weevils captured. The other variables (X) which were correlated with this Y were: the temperature at all times during the experiment,

Table 2. Regional response of different age classes of adult alfalfa weevils to light intensity.

Region	Age Class		
	New Generation (summer)	Overwintering (fall and spring)	Overwintered (summer)
W. Ore.	strong negative	none	--
E. Ore.	strong negative	none	negative
C. Ore.	strong negative	strong negative	--
Calif.[1]	--	strong negative	--
Utah[2]	strong negative	none	negative
Alabama[3]	strong negative	strong negative	--

[1] Egyptian alfalfa weevil, Hypera brunnepenis (Appendix Table 2).

[2] Western strain of Hypera postica (Southwick and Davis, 1968).

[3] Eastern strain of Hypera postica (Bass, 1967).

Table 3. Correlation coefficients for Western Oregon adult alfalfa weevil activity cycles.

Date, age, and sex		R values when Y=no. of weevils and: X=Temp. all times	X=Temp. daylight	X=Temp. dark	X=light intensity
8/24/72	total	-[1]	--	++	md
9/28/72	total	0	-	0	md
10/11/72	total	+	++	+++	md
	males	+	+++	+++	md
	females	+	++	+++	md
11/10/72	total	+	+	++	++
	males	++	+	++	++
	females	0	+	++	+
4/4/73	total	+++	++	+++	+++
	males	++	++	+++	++
	females	++	++	+++	+++
5/2/73	total	+	+	+++	+
	males	0	0	+++	+
	females	+	++	+++	+
6/20/73	total	--	--	+++	---
new only	males	--	--	+++	---
	females	--	--	++	---
8/1/73	total	-	-	+++	-
new only	males	-	0	+++	--
	females	-	-	+++	-

[1] For explanation of symbolic R values see footnote, Table 4.

Table 4. Correlation coefficients for Eastern Oregon adult alfalfa weevil activity cycles.

Date, age, and sex		R values when Y=no. of weevils and: X=Temp. all times	X=Temp. daylight	X=Temp. dark	X=Light intensity
6/7/73	total	0[1]	0	++	+
	males	0	0	+	0
	females	+	0	++	0
7/12/73 "new"	total	--	--	++	---
	total	--	--	+++	---
	males	--	--	++	---
	females	--	--	+++	---
"overwintered"	total	--	--	++	---
	males	-	-	+	--
	females	--	--	0	---

[1] Symbolic values of R explained:

Symbol	Range of R values rep.
---	-1.000 to -0.800
--	-0.799 to -0.500
-	-0.499 to -0.200
0	-0.199 to 0.199
+	0.200 to 0.499
++	0.500 to 0.799
+++	0.800 to 1.000
md	missing data

Table 5. Correlation coefficients for Central Oregon adult alfalfa weevil activity cycles with comparison of spring activity of Egyptian alfalfa weevils in California. [1]

Date, age, and sex		R values when Y=no. of weevils and: X=Temp. all times	X=Temp. daylight	X=Temp. dark	X=Light intensity
5/16/73	total	0 [2]	++	+++	-
	males	0	+	+++	-
	females	0	+	+++	-
7/24/73 "new"					
	total	-	0	+++	--
	males	-	0	+++	--
	females	0	0	+++	--
"overwintered"					
	total	0	++	0	0
Calif. 3/27/73					
	total	0	+	+++	-

[1] Data for Egyptian weevil from Appendix Table 4.

[2] For explanation of symbolic R values see footnote, Table 4.

the temperature during the night when the light intensity was less than five foot candles, the temperature during the day when the light intensity was greater than five foot candles, and finally, the light intensity over the entire 24 hour experimental period. In order to facilitate comparison, the R values are grouped into seven classes and represented symbolically.

DISCUSSION

This investigation has important implications to the study of adult alfalfa weevil population dynamics. Since such pronounced diel activity patterns exist, it is very important to take them into account before drawing conclusions about changes in a population. For example, even if an investigator were careful to sample during the same time of day, a lack of knowledge of these cycles might allow him to make false conclusions when the sampling intervals are six weeks or more apart. The data from Eastern Oregon show this quite well. On June 6, 1973, 194 adults were captured at noon with 100 sweeps. On July 12, 1973, only 25 adults were captured at noon with 100 sweeps. On the surface this looks like an 87% reduction in the number of adults in the field. In reality, though, there had actually been a 230% increase in the number of adults present. While the maximum number of weevils were captured at noon on June 6, the maximum number were not captured until ten PM on July 12 (Appendix Tables 80 and 90).

Being able to measure changes in the numbers of a pest species present in a field is very important to those involved in evaluating control measures. For this reason a knowledge of alfalfa weevil activity cycles and how they change seasonally might potentially lead to better ways to manage this pest.

A knowledge of the activity cycles of the alfalfa weevil can also be useful in bringing about the most efficient collection of adults for laboratory studies or the rearing of natural enemies.

A third possible application of the findings of this investigation would be in predicting future larval infestations. Blickenstaff, Huggans, and Schroder (1972) found that populations of adult alfalfa weevils in either November or March correlated closely with peak larval populations in the succeeding generation in Maryland and New Jersey. If a similar relationships exists with alfalfa weevils in Oregon, a knowledge of the activity cycles in November or March can be used to gain the most accurate knowledge of the numbers of adults present and thus the best prediction of future larval infestations. This knowledge in turn might aid growers in their management decisions.

This investigation is also helpful in that it both confirms the findings of earlier investigations, and helps fill gaps in the knowledge of the diel activity cycles of adult alfalfa weevils. Earlier investigators frequently mentioned that a great increase in the number of weevils captured could be expected after dark during the summer. This investigation confirmed that this was also true for weevils in Oregon. Southwick and Davis (1968) found that no negative light reaction occurred with overwintering adults in the spring in Utah. This investigation showed that this was true for both Western and

Eastern Oregon. One gap in the knowledge which was filled is the discovery that in Oregon, instead of having uniformly high numbers during the night, such as Poinar and Gyrisco found in New York (1960), the numbers of weevils varied in a temperature dependent manner with significantly fewer being captured as the night progressed. A second unique finding was that new generation adult weevils in the early summer tended to react in such a way as to have an almost linear inverse relationship to the light intensity. This is in contrast with the findings of Poinar and Gyrisco (1964) that the alfalfa weevil exhibited an "all-or-none" response in that there was no significant change in the numbers found on alfalfa until the light intensity fell to a critical value of about four foot candles. Interestingly, the Oregon weevils tended to shift their behavior as the summer progressed so that from mid to late summer their behavior appeared to be in agreement with the "all-or-none" response as described by Poinar and Gyrisco. Finally, this study is more complete than earlier investigations because the seasonal variation in the activity cycles was studied more thoroughly and a better use of statistical analysis was made.

Although this investigation makes some valuable contributions, it also brings up some interesting questions. First, the discrepancy in the behavior of overwintering weevils in the spring in Central Oregon as compared to those in Western and Eastern Oregon calls

for further experiments to see if this was caused by a true biological difference or if it was just an artifact produced by some other factor. That the behavior of the Egyptian weevil and the eastern strain of the alfalfa weevil show a similar pattern in the spring (Table 2) might indicate that a true biological difference does exist. In conversations with Robert Van den Bosch of the University of California at Berkeley, it was learned that the Egyptian alfalfa weevil is now widespread in the Sacramento Valley of California. Since there are presently no quarantines on the movement of hay from California into Oregon, it is quite possible that Egyptian weevils could have been transported into Central Oregon by this means. According to Van den Bosch and Marble (1971) differentiating between the alfalfa weevil, Hypera postica, and the Egyptian weevil, Hypera brunnepenis, is difficult because no reliable structural differences have been found to separate them. The diel cycle in the spring, though, might give a simple tool for their separation since the alfalfa weevils (western strain) show a peak of activity during the day while the Egyptian weevils are most abundant after dark.

In the past, both with alfalfa weevils and with other insects, diel activity cycles have usually been studied only during a short portion of the year. This was usually probably done under the assumption that these cycles are fixed in a species and therefore do not undergo seasonal variation. This investigation has shown that in the western

strain of the alfalfa weevil in Oregon, at least, quite the opposite case is true. A very dramatic shift from the summer to the fall and spring cycles was recorded. Therefore it would seem profitable for those working on the diel cycles of other species to make occasional tests throughout the time of year when the insects are active.

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APPENDIX

APPENDIX TABLE 1. AVERAGE HEIGHT OF ALFALFA IN EACH EXPERIMENT.

Date	Region	Average Height of Alfalfa			
		Block A	Block B	Block C	Block D
Aug. 24-25, 1972	Western Ore.	18"	20"	13"	15"
Sept. 28-29, 1972	Western Ore.	25"	24"	19"	21"
Oct. 11-12, 1972	Western Ore.	23"	21"	19"	19"
Nov. 10, 1972	Western Ore.	-	-	-	-
Mar 27-28, 1973	Davis, Cal.	-	-	14"	14"
Apr. 4-5, 1973	Western Ore.	10"	-	-	-
May 2-3, 1973	Western Ore.	29"	-	-	-
May 16-17, 1973	Central Ore.	7"	7"	5"	8"
June 6-7, 1973	Eastern Ore.	21"	17"	16"	19"
June 20-21, 1973	Western Ore.	21"	20"	20"	21"
July 12-13, 1973	Eastern Ore.	18"	17"	17"	17"
July 24-25, 1973	Central Ore.	17"	19"	20"	18"
Aug 1-2, 1973	Western Ore.	9"	12"	17"	19"

APPENDIX TABLE 2. DATA AND PARTIAL ANALYSIS FOR EXPERIMENT CONDUCTED AT DAVIS, CALIFORNIA, MARCH 27-28, 1973.

Time (PST)	Light intensity	Temp.	No. of adults[1] Block C	Block D	Results of Duncan's NMR Test	
12:30 PM	6200 f. c.	16.0°C.	1	0		b
3:30 PM	5000 f. c	16.5°C.	6	3	a	b
5:30 PM	650 f. c.	15.0°C.	1	1		b
6:30 PM	20 f. c.	12.5°C.	0	0		b
7:30 PM	0 f. c.	11.0°C.	15	2	a	
9:30 PM	0 f. c.	10.0°C.	6	12	a	
12:30 AM	0 f. c.	6.5°C	1	1		b
5:30 AM	0 f. c.	5.0°C	1	0		b
6:30 AM	350 f. c.	7.5°C	0	0		b
7:30 AM	2000 f. c.	11.0°C.	0	0		b
9:30 AM	5500 f. c.	16.0°C.	0	0		b

[1] only overwintered adults

APPENDIX TABLE 3. ANALYSIS OF VARIANCE FOR DATA TAKEN AT DAVIS, CALIFORNIA, MARCH 27-28, 1973.

Source	DF	SS	MS	F
Time	10	238.364	23.834	2.349
Replica	1	6.545	6.545	0.645
Time x Replica	10	101.455	10.145	
Total	21	346.364		

APPENDIX TABLE 4. CORRELATION COEFFICIENTS FOR DATA TAKEN AT DAVIS, CALIFORNIA, MARCH 27-28, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	0.0079	0.0001
Temp. daylight	No. of adults	0.4909	0.2409
Temp. dark	No. of adults	0.9671	0.9353
Light intensity	No. of adults	-0.2145	0.0460

APPENDIX TABLE 5. TEMPERATURES WITHIN DIFFERENT BLOCKS AT DIFFERENT TIMES ON OCTOBER 4, 1973, ONE MILE EAST OF CORVALLIS.

Time	Block A	Block B	Block C	Block D
9:30 AM	7.5°C	8.0°C	8.0°C	8.0°C
1:30 PM	16.0°C	16.0°C	16.5°C	16.5°C
5:30 PM	17.5°C	17.0°C	16.5°C	16.0°C
9:30 PM	10.0°C	10.0°C	9.5°C	9.5°C

APPENDIX TABLE 6. RAW DATA FROM EXPERIMENT CONDUCTED FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

Time (PDT)	Temp.	Light intensity	Number of Weevil Adults[1]							
			Block A		Block B		Block C		Block D	
			♂	♀	♂	♀	♂	♀	♂	♀
10:00 AM	22.0°C	5500 f. c.	1	0	0	0	0	0	0	0
1:00 PM	31.0°C	6500 f. c.	0	0	0	0	0	0	0	0
4:00 PM	33.0°C	5500 f. c.	0	0	0	0	0	0	0	0
7:00 PM	29.0°C	2000 f. c.	0	0	0	0	0	0	0	0
8:00 PM	25.0°C	500 f. c.	0	0	0	0	0	1	0	0
9:00 PM	24.0°C	10 f. c.	1	0	0	0	1	0	0	0
10:00 PM	22.0°C	0 f. c.	3	2	7	11	7	3	8	7
1:00 AM	17.5°C	0 f. c.	1	3	4	0	6	6	4	2
4:00 AM	12.0°C	0 f. c.	1	2	2	2	3	4	4	0
5:00 AM	10.0°C	0 f. c.	4	1	0	1	5	2	2	2
6:00 AM	9.0°C	94 f. c.	0	1	0	0	0	0	0	0
7:00 AM	12.0°C	600 f. c.	0	0	0	0	0	0	0	0

[1] only data on new generation weevils is given because only three overwintered weevils were found during the entire experiment, all at 4:00 AM.

APPENDIX TABLE 7. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF MALES PLUS FEMALES CAPTURED DURING EACH TIME INTERVAL FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	1	2.08%	c
1:00 PM	0	0%	c
4:00 PM	0	0%	c
7:00 PM	0	0%	c
8:00 PM	1	2.08%	c
9:00 PM	2	4.16%	c
10:00 PM*	48	100.00%	a
1:00 AM*	26	54.16%	b
4:00 AM*	18	37.50%	b
5:00 AM*	17	35.41%	b
6:00 AM	1	2.08%	c
7:00 AM	0	0%	c

*dark

APPENDIX TABLE 8. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF MALES CAPTURED DURING EACH TIME INTERVAL FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	1	4.00%	c
1:00 PM	0	0%	c
4:00 PM	0	0%	c
7:00 PM	0	0%	c
8:00 PM	0	0%	c
9:00 PM	2	8.00%	c
10:00 PM*	25	100.00%	a
1:00 AM*	15	60.00%	b
4:00 AM*	10	40.00%	b
5:00 AM*	11	44.00%	b
6:00 AM	0	0%	c
7:00 AM	0	0%	c

*dark

APPENDIX TABLE 9. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF FEMALES CAPTURED DURING EACH TIME INTERVAL FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	0	0%	c
1:00 PM	0	0%	c
4:00 PM	0	0%	c
7:00 PM	0	0%	c
8:00 PM	1	4.34%	c
9:00 PM	0	0%	c
10:00 PM*	23	100.00%	a
1:00 AM*	11	47.82%	b
4:00 AM*	8	34.78%	b c
5:00 AM*	6	26.08%	b c
6:00 AM	1	4.34%	c
7:00 AM	0	0%	c

*dark

APPENDIX TABLE 10. ANALYSIS OF VARIANCE OF MALES PLUS FEMALES FOR DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

Source of Var.	DF	SS	MS	F
Time	11	629.500	57.205	11.929**
Replica	3	13.750	4.583	0.956
Time X Replica	33	158.250	4.795	
Total	47	801.250		

**significant at the 1% level

APPENDIX TABLE 11. ANALYSIS OF VARIANCE OF MALES FOR DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

Source of Var.	DF	SS	MS	F
Time	11	183.667	16.697	12.864**
Replica	3	6.167	2.056	1.584
Time X Replica	33	42.833	1.298	
Total	47	232.667		

**significant at the 1% level

APPENDIX TABLE 12. ANALYSIS OF VARIANCE OF FEMALES FOR DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

Source of Var.	DF	SS	MS	F
Time	11	135.917	12.356	5.256**
Replica	3	2.417	0.806	0.343
Time X Replica	33	77.583	2.351	
Total	47	215.917		

**significant at the 1% level

APPENDIX TABLE 13. CORRELATION COEFFICIENTS OF MALE PLUS FEMALE DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	-0.2445	0.0598
Temp. daylight	No. of adults	-0.2583	0.0667
Temp. dark	No. of adults	0.9409	0.8853
Light intensity	No. of adults	-0.4488	0.2014

APPENDIX TABLE 14. CORRELATION COEFFICIENTS OF MALE DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	-0.2685	0.0721
Temp. daylight	No. of males	0.0139	0.0002
Temp. dark	No. of males	0.9364	0.8769
Light intensity	No. of males	-0.4572	0.2091

APPENDIX TABLE 15. CORRELATION COEFFICIENTS OF FEMALE DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, AUGUST 1-2, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	-0.2139	0.0458
Temp. daylight	No. of females	-0.4374	0.1913
Temp. dark	No. of females	0.9378	0.8795
Light intensity	No. of females	-0.4341	0.1884

APPENDIX TABLE 16. RAW DATA FROM EXPERIMENT CONDUCTED ONE MILE EAST OF CORVALLIS, AUGUST 24-25, 1972.

Time (PDT)	Temp.	Number of adult weevils in:			
		Block A	Block B	Block C	Block D
7:00 AM	11.0°C	3	3	2	2
10:00 AM	21.0°C	0	0	0	0
1:00 PM	27.0°C	1	0	0	0
4:00 PM	27.0°C	0	0	0	0
7:00 PM	26.0°C	1	0	0	0
8:00 PM	22.0°C	1	0	0	0
9:00 PM*	21.5°C	7	4	2	3
10:00 PM*	17.0°C	8	1	11	7
11:00 PM*	16.5°C	8	1	16	5
12:00 AM*	15.5°C	1	6	5	7
1:00 AM*	14.0°C	3	1	2	1
4:00 AM*	12.0°C	0	0	2	1
5:00 AM*	11.0°C	7	2	1	3
6:00 AM*	9.5°C	1	0	0	1
7:00 AM	10.0°C	0	0	1	2

*dark

APPENDIX TABLE 17. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF ADULTS CAPTURED DURING EACH TIME INTERVAL ONE MILE EAST OF CORVALLIS, AUGUST 24-25, 1972.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
7:00 AM	10	33.33%	c d e
10:00 AM	0	0%	e
1:00 PM	1	3.33%	e
4:00 PM	0	0%	e
7:00 PM	1	3.33%	e
8:00 PM	1	3.33%	e
9:00 PM*	16	53.33%	b c d
10:00 PM*	27	90.00%	a b
11:00 PM*	30	100.00%	a
12:00 AM*	19	63.33%	a b c
1:00 AM*	7	23.33%	c d e
4:00 AM*	3	10.00%	d e
5:00 AM*	13	43.33%	b c d e
6:00 AM*	1	3.33%	d e
7:00 AM	3	10.00%	d e

*dark

APPENDIX TABLE 18. ANALYSIS OF VARIANCE FOR DATA TAKEN ONE MILE EAST OF CORVALLIS, AUGUST 24-25, 1972.

Source of Var.	DF	SS	MS	F
Time	14	352.433	25.174	4.872**
Replica	3	24.717	8.239	1.594
Time X Replica	42	217.033	5.167	
Total	59	594.183		

**significant at the 1% level

APPENDIX TABLE 19. CORRELATION COEFFICIENTS FOR DATA TAKEN ONE MILE EAST OF CORVALLIS, AUGUST 24-25, 1972.

X variable	Y variable	Correlation coefficient	R^2 value
Temp. all times	No. adults	-0.2332	0.0544
Temp. daylight	No. adults	-0.7373	0.5437
Temp. dark	No. adults	0.6549	0.4290

APPENDIX TABLE 20. RAW DATA FROM EXPERIMENT CONDUCTED ONE MILE EAST OF CORVALLIS, SEPTEMBER 28-29, 1972.

Time (PDT)	Temp.	Number of adult weevils			
		Block A	Block B	Block C	Block D
9:00 AM	9.0°C	1	2	8	3
12:00 PM	12.5°C	3	0	1	4
2:30 PM	16.0°C	3	0	0	4
5:30 PM	15.5°C	6	1	2	4
8:30 PM*	13.0°C	8	9	13	0
11:30 PM*	12.0°C	4	9	9	1
2:30 AM*	5.5°C	12	7	21	8
5:30 AM*	4.0°C	1	2	2	3

*dark

APPENDIX TABLE 21. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF ADULTS CAPTURED DURING EACH TIME INTERVAL ONE MILE EAST OF CORVALLIS, SEPTEMBER 28-29, 1972.

Time (PDT)	Total captured	% of greatest total at any one time	Results of Duncan's NMR Test	
9:00 AM	14	29.16%		b
12:00 PM	8	16.66%		b
2:30 PM	7	14.58%		b
5:30 PM	13	27.08%		b
8:30 PM*	30	62.50%	a	b
11:30 PM*	23	47.91%		b
2:30 AM*	48	100.00%	a	
5:30 AM*	8	16.66%		b

*dark

APPENDIX TABLE 22. ANALYSIS OF VARIANCE FOR DATA TAKEN ONE MILE EAST OF CORVALLIS, SEPTEMBER 28-29, 1972.

Source of Var.	DF	SS	MS	F
Time	7	356.219	50.889	4.069**
Replica	3	63.594	21.198	1.695
Time X Replica	21	262.656	12.507	
Total	31	682.469		

**significant at the 1% level

APPENDIX TABLE 23. CORRELATION COEFFICIENTS FOR DATA TAKEN ONE MILE EAST OF CORVALLIS, SEPTEMBER 28-29, 1972.

X variable	Y variable	R value	R^2 value
Temp. all times	No. adults	-0.3412	0.1164
Temp. daylight	No. adults	-0.4999	0.2499
Temp. dark	No. adults	0.0968	0.0094

APPENDIX TABLE 24. RAW DATA FROM EXPERIMENT CONDUCTED ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

Time (PDT)	Temp.	Block A		Block B		Block C		Block D	
		♂	♀	♂	♀	♂	♀	♂	♀
9:00 AM	7.0°C	0	1	3	3	0	0	0	0
12:00 PM	10.0°C	2	1	2	2	1	0	2	1
3:00 PM	12.5°C	9	6	1	0	17	11	3	1
6:00 PM	12.0°C	0	1	6	2	4	2	5	2
9:00 PM*	6.0°C	3	5	1	0	2	1	6	1
12:00 AM*	10.5°C	8	6	10	5	7	2	1	2
3:00 AM*	7.5°C	3	2	4	2	7	0	8	4
6:00 AM*	8.0°C	6	3	6	2	9	7	1	2

*dark

APPENDIX TABLE 25. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF ADULTS CAPTURED DURING EACH TIME INTERVAL ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's New Mult. Range Test
9:00 AM	7	14.58%	b
12:00 PM	11	22.91%	ab
3:00 PM	48	100.00%	a
6:00 PM	22	45.83%	ab
9:00 PM*	19	39.58%	ab
12:00 AM*	41	85.41%	ab
3:00 AM*	30	62.50%	ab
6:00 AM*	36	75.00%	ab

*dark

APPENDIX TABLE 26. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF ADULT MALES CAPTURED DURING EACH TIME INTERVAL ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

Time (PDT)	Total males captured	% of greatest no. at any one time	Results of Duncan's NMR Test
9:00 AM	3	10.00%	b
12:00 PM	7	23.33%	a b
3:00 PM	30	100.00%	a
6:00 PM	15	50.00%	a b
9:00 PM*	12	40.00%	a b
12:00 AM*	26	86.66%	a b
3:00 AM*	22	73.33%	a b
6:00 AM*	22	73.33%	a b

*dark

APPENDIX TABLE 27. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF ADULT FEMALES CAPTURED DURING EACH TIME INTERVAL ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

Time (PDT)	Total females captured	% of greatest no. at any one time	Results of Duncan's NMRT
9:00 AM	4	22.22%	a
12:00 PM	4	22.22%	a
3:00 PM	18	100.00%	a
6:00 PM	7	38.88%	a
9:00 PM*	7	38.88%	a
12:00 AM*	15	83.33%	a
3:00 AM*	8	44.44%	a
6:00 AM*	14	77.77%	a

*dark

APPENDIX TABLE 28. ANALYSIS OF VARIANCE OF MALES PLUS FEMALES FOR DATA TAKEN ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

Source of Var.	DF	SS	MS	F
Time	7	367.875	52.554	1.615
Replica	3	63.625	21.208	0.652
Time X Replica	21	683.375	32.542	
Total	31	1114.875		

APPENDIX TABLE 29. ANALYSIS OF VARIANCE OF MALES FOR DATA TAKEN ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

Source of Var.	DF	SS	MS	F
Time	7	156.219	22.317	1.789
Replica	3	30.344	10.115	0.811
Time X Replica	21	261.906	12.472	
Total	31	448.469		

APPENDIX TABLE 30. ANALYSIS OF VARIANCE OF FEMALES FOR DATA TAKEN ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

Source of Var.	DF	SS	MS	F
Time	7	49.469	7.067	1.176
Replica	3	12.094	4.031	0.671
Time X Replica	21	126.156	6.007	
Total	31	187.719		

APPENDIX TABLE 31. CORRELATION COEFFICIENTS OF MALE PLUS FEMALE DATA TAKEN ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	0.4468	0.1996
Temp. daylight	No. of adults	0.7960	0.6336
Temp. dark	No. of adults	0.9424	0.8881

APPENDIX TABLE 32. CORRELATION COEFFICIENTS OF MALE DATA TAKEN ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	0.4268	0.1821
Temp. daylight	No. of males	0.8441	0.7124
Temp. dark	No. of males	0.9204	0.8471

APPENDIX TABLE 33. CORRELATION COEFFICIENTS OF FEMALE DATA TAKEN ONE MILE EAST OF CORVALLIS, OCTOBER 11-12, 1972.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	0.4589	0.2106
Temp. daylight	No. of females	0.6952	0.4833
Temp. dark	No. of females	0.8510	0.7243

APPENDIX TABLE 34. RAW DATA FROM EXPERIMENT CONDUCTED ONE MILE EAST OF CORVALLIS, NOVEMBER 10-11, 1972

Time (PST)	Temp.	Light intensity	Number of Adult Weevils							
			Block A		Block B		Block C		Block D	
			♂	♀	♂	♀	♂	♀	♂	♀
9:30 AM	10.0°C	1600[1] f.c.	2	4	12	6	14	8	15	12
12:30 PM	17.0°C	1500 f.c.	20	11	19	10	18	13	11	6
3:30 PM	15.5°C	600 f.c.	8	6	8	8	1	4	1	2
6:30 PM	9.0°C	0 f.c.	12	12	11	11	7	2	9	10
9:30 PM	7.0°C	0 f.c.	2	10	4	6	4	8	9	5
12:30 AM	4.0°C	0 f.c.	8	12	10	12	6	1	0	3

[1]light intensity units are foot candles.

APPENDIX TABLE 35. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF MALES PLUS FEMALES CAPTURED DURING EACH TIME INTERVAL ONE MILE EAST OF CORVALLIS, NOVEMBER 10-11, 1972

Time (PST)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
9:30 AM	73	67.59%	ab
12:30 PM	108	100.00%	a
3:30 PM	38	35.18%	b
6:30 PM*	75	69.44%	ab
9:30 PM*	48	44.44%	b
12:30 AM*	52	48.14%	b

*dark

APPENDIX TABLE 36. TOTAL NUMBER, PERCENTAGE, AND SIGNFICANCE OF MALES CAPTURED DURING EACH TIME INTERVAL ONE MILE EAST OF CORVALLIS, NOVEMBER 10-11, 1972.

Time (PST)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
9:30 AM	43	63.23%	a b
12:30 PM	68	100.00%	a
3:30 PM	18	26.47%	b
6:30 PM*	39	57.35%	b
9:30 PM*	19	27.94%	b
12:30 AM*	24	35.29%	b

*dark

APPENDIX TABLE 37. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF FEMALES CAPTURED DURING EACH TIME INTERVAL ONE MILE EAST OF CORVALLIS, NOVEMBER 10-11, 1972.

Time (PST)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
9:30 AM	30	75.00%	a
12:30 PM	40	100.00%	a
3:30 PM	20	50.00%	a
6:30 PM*	35	87.50%	a
9:30 PM*	29	72.50%	a
12:30 AM*	28	70.00%	a

*dark

APPENDIX TABLE 38. ANALYSIS OF VARIANCE OF MALES PLUS FEMAES FOR DATA TAKEN NOVEMBER 10-11, ONE MILE EAST OF CORVALLIS.

Source of Var.	DF	SS	MS	F
Time	5	799.333	159.867	3.094*
Replica	3	141.500	47.167	0.913
Time X Replica	15	775.000	51.667	
Total	23	1715.833		

*significant at the 5% level

APPENDIX TABLE 39. ANALYSIS OF VARIANCE OF MALES FOR DATA TAKEN ONE MILE EAST OF CORVALLIS, NOVEMBER 10-11, 1972.

Source of Var.	DF	SS	MS	F
Time	5	458.708	91.742	5.082**
Replica	3	32.458	10.819	0.599
Time X Replica	15	270.792	18.053	
Total	23	761.958		

**significant at the 1% level

APPENDIX TABLE 40. ANALYSIS OF VARIANCE OF FEMALES FOR DATA TAKEN ONE MILE EAST OF CORVALLIS, NOVEMBER 10-11, 1972.

Source of Var.	DF	SS	MS	F
Time	5	57.333	11.467	0.813
Replica	3	48.833	16.278	1.154
Time X Replica	15	211.667	14.111	
Total	23	317.833		

APPENDIX TABLE 41. CORRELATION COEFFICIENTS OF MALE PLUS FEMALE DATA TAKEN ONE MILE EAST OF CORVALLIS, NOVEMBER 10-11, 1972.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	0.4282	0.1833
Temp. daylight	No. of adults	0.2035	0.0414
Temp. dark	No. of adults	0.7135	0.5092
Light intens.	No. of adults	0.6101	0.3722

APPENDIX TABLE 42. CORRELATION COEFFICIENTS OF MALE DATA TAKEN ONE MILE EAST OF CORVALLIS, NOVEMBER 10-11, 1972.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	0.5176	0.2679
Temp. daylight	No. of males	0.2035	0.0414
Temp. dark	No. of males	0.6373	0.4049
Light intens.	No. of males	0.7072	0.5001

APPENDIX TABLE 43. CORRELATION COEFFICIENTS OF FEMALE DATA TAKEN ONE MILE EAST OF CORVALLIS, NOVEMBER 10-11, 1972.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	0.1432	0.0205
Temp. daylight	No. of females	0.2035	0.0414
Temp. dark	No. of females	0.8746	0.7650
Light intensity	No. of females	0.3018	0.0911

APPENDIX TABLE 44. RAW DATA FROM EXPERIMENT CONDUCTED SIX MILES NORTH OF CORVALLIS, APRIL 4-5, 1973.

Time (PST)	Temp.	Light intensity	Number of Adult Weevils							
			Block A		Block B		Block C		Block D	
			♂	♀	♂	♀	♂	♀	♂	♀
10:00 AM	12.0°C	4500 f. c.	10	17	27	26	28	52	18	22
1:00 PM	20.5°C	6000 f. c.	14	16	17	26	22	30	11	28
4:00 PM	20.0°C	3000 f. c	15	14	15	22	28	31	15	15
5:00 PM	16.5°C	1500 f. c.	7	15	21	14	17	21	20	19
6:00 PM	15.0°C	500 f. c.	14	13	11	11	10	11	16	12
7:00 PM	14.5°C	10 f. c.	4	11	5	10	10	14	11	10
8:00 PM	11.0°C	0 f. c.	16	8	5	4	15	9	6	3
11:00 PM	7.5°C	0 f. c.	4	10	6	2	2	1	3	3
2:00 AM	6.5°C	0 f. c.	0	1	1	3	4	4	2	1
5:00 AM	4.5°C	0 f. c.	1	1	3	4	1	1	3	1
6:00 AM	4.0°C	85 f. c.	1	2	3	5	8	11	3	3
7:00 AM	7.0°C	1400 f. c.	8	10	8	13	17	16	6	10

APPENDIX TABLE 45. TOTAL NUMBER, PERCENTAGE, AND SIGNFICANCE OF MALES PLUS FEMALES CAPTURED DURING EACH TIME INTERVAL SIX MILES NORTH OF CORVALLIS, APRIL 4-5, 1973.

Time (PST)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	201	100.00%	a
1:00 PM	164	81.59%	a b
4:00 PM	155	77.11%	a b
5:00 PM	134	66.66%	b c
6:00 PM	98	48.75%	c d
7:00 PM	75	37.31%	d e
8:00 PM*	67	33.33%	d e
11:00 PM*	31	15.42%	e f
2:00 AM*	16	7.96%	f
5:00 AM*	15	7.46%	f
6:00 AM	36	17.91%	e f
7:00 AM	88	43.78%	c d

*dark

APPENDIX TABLE 46. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF MALES CAPTURED DURING EACH TIME INTERVAL SIX MILES NORTH OF CORVALLIS, APRIL 4-5, 1973.

Time (PSTP	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test					
10:00 AM	83	100.00%	a					
1:00 PM	64	77.10%	a	b	c			
4:00 PM	73	87.95%	a	b				
5:00 PM	65	78.31%	a	b	c			
6:00 PM	51	61.44%		b	c	d		
7:00 PM	30	36.14%				d	e	f
8:00 PM*	42	50.60%			c	d		
11:00 PM*	15	18.07%					e	f
2:00 AM*	7	8.43%						f
5:00 AM*	8	9.63%						f
6:00 AM	15	18.07%					e	f
7:00 AM	39	46.98%			c	d	e	

*dark

APPENDIX TABLE 47. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF FEMALES CAPTURED DURING EACH TIME INTERVAL SIX MILES NORTH OF CORVALLIS, APRIL 4-5, 1973.

Time (PST)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	117	100.00%	a
1:00 PM	100	85.47%	a b
4:00 PM	82	70.08%	b
5:00 PM	69	58.97%	b c
6:00 PM	47	40.17%	c d
7:00 PM	45	38.46%	c d
8:00 PM*	24	20.51%	d e
11:00 PM*	16	13.67%	d e
2:00 AM*	9	7.69%	e
5:00 AM*	7	5.98%	e
6:00 AM	21	17.94%	d e
7:00 AM	49	41.88%	c d

*dark

APPENDIX TABLE 48. ANALYSIS OF VARIANCE OF MALES PLUS FEMALES FOR DATA TAKEN APRIL 4-5, 1973, SIX MILES NORTH OF CORVALLIS.

Source of Var.	DF	SS	MS	F
Time	11	10569.500	960.864	14.503**
Replica	3	1062.167	354.056	5.344**
Time X Replica	33	2186.333	66.253	
Total	47	13818.000		

**significant at the 1% level

APPENDIX TABLE 49. ANALYSIS OF VARIANCE OF MALES FOR DATA TAKEN SIX MILES NORTH OF CORVALLIS, APRIL 4-5, 1973.

Source of Var.	DF	SS	MS	F
Time	11	1929.000	175.364	9.513**
Replica	3	203.667	67.889	3.683*
Time X Replica	33	608.333	18.434	
Total	47	2741.000		

*significant at the 5% level

**significant at the 1% level

APPENDIX TABLE 50. ANALYSIS OF VARIANCE OF FEMALES FOR DATA TAKEN SIX MILES NORTH OF CORVALLIS, APRIL 4-5, 1973.

Source of Var.	DF	SS	MS	F
Time	11	3648.917	331.720	12.292**
Replica	3	350.417	116.806	4.328*
Time X Replica	33	890.583	26.987	
Total	47	4889.917		

*significant at the 5% level

**significant at the 1% level

APPENDIX TABLE 51. CORRELATION COEFFICIENTS OF MALE PLUS FEMALE DATA TAKEN SIX MILES NORTH OF CORVALLIS, APRIL 4-5, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	0.8016	0.6425
Temp. daylight	No. of adults	0.6856	0.4700
Temp. dark	No. of adults	0.9567	0.9152
Light intensity	No. of adults	0.8495	0.7217

APPENDIX TABLE 52. CORRELATION COEFFICIENTS OF MALE DATA TAKEN SIX MILES NORTH OF CORVALLIS, APRIL 4-5, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	0.7913	0.6261
Temp. daylight	No. of males	0.6626	0.4390
Temp. dark	No. of males	0.9347	0.8737
Light intensity	No. of males	0.7732	0.5978

APPENDIX TABLE 53. CORRELATION COEFFICIENTS OF FEMALE DATA TAKEN SIX MILES NORTH OF CORVALLIS, APRIL 4-5, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	0.7365	0.5424
Temp. daylight	No. of females	0.5852	0.3424
Temp. dark	No. of females	0.9707	0.9422
Light intensity	No. of females	0.9071	0.8228

APPENDIX TABLE 54. RAW DATA FROM EXPERIMENT CONDUCTED SIX MILES NORTH OF CORVALLIS, MAY 2-3, 1973.

Time (PDT)	Temp.	Light intensity	Number of Adult Weevils							
			Block A		Block B		Block C		Block D	
			♂	♀	♂	♀	♂	♀	♂	♀
10:00 AM	11.5°C	2300 f. c.	5	1	3	2	4	9	12	8
1:00 PM	15.0°C	5600 f. c.	6	4	5	3	8	11	14	10
4:00 PM	13.5°C	1300 f. c.	3	3	5	4	4	5	7	2
7:00 PM	14.5°C	400 f. c.	5	3	3	4	12	17	12	8
8:00 PM	12.5°C	0 f. c.	4	9	4	3	9	3	4	2
9:00 PM	12.0°C	0 f. c.	7	5	8	7	7	8	11	8
12:00 AM	11.0°C	0 f. c.	3	4	8	6	8	7	11	7
5:30 AM	9.0°C	0 f. c.	8	5	1	8	7	5	8	3
6:30 AM	9.0°C	150 f. c.	4	6	6	0	6	3	9	8
7:30 AM	10.0°C	800 f. c.	4	4	6	2	12	5	11	8

APPENDIX TABLE 55. TOTAL NUMBER, PERCENTAGE, ANDSIGNIFICANCE OF MALES PLUS FEMALES CAPTURED DURING EACH TIME INTERVAL SIX MILES NORTH OF CORVALLIS, MAY 2-3, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	44	68.75%	a b
1:00 PM	61	95.31%	a b
4:00 PM	33	51.56%	b
7:00 PM	64	100.00%	a
8:00 PM	38	59.37%	a b
9:00 PM*	61	95.31%	a b
12:00 AM*	54	84.37%	a b
5:30 AM*	45	70.31%	a b
6:30 AM	42	65.62%	a b
7:30 AM	52	81.25%	a b

*dark

APPENDIX TABLE 56. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF MALES CAPTURED DURING EACH TIME INTERVAL ON MAY 2-3, 1973, SIX MILES NORTH OF CORVALLIS.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	24	72.72%	a
1:00 PM	33	100.00%	a
4:00 PM	19	57.57%	a
7:00 PM	32	96.96%	a
8:00 PM	21	63.63%	a
9:00 PM*	33	100.00%	a
12:00 AM*	30	90.90%	a
5:30 AM*	24	72.72%	a
6:30 AM	25	75.75%	a
7:30 AM	33	100.00%	a

*dark

APPENDIX TABLE 57. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF FEMALES CAPTURED DURING EACH TIME INTERVAL SIX MILES NORTH OF CORVALLIS, MAY 2-3, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	20	62.50%	a
1:00 PM	28	87.50%	a
4:00 PM	14	43.75%	a
7:00 PM	32	100.00%	a
8:00 PM	17	53.12%	a
9:00 PM*	28	87.50%	a
12:00 AM*	24	75.00%	a
5:30 AM*	21	65.62%	a
6:30 AM	17	53.12%	a
7:30 AM	19	59.37%	a

*dark

APPENDIX TABLE 58. ANALYSIS OF VARIANCE OF MALES PLUS FEMAES FOR DATA TAKEN SIX MILES NORTH OF CORVALLIS, MAY 2-3, 1973.

Source of Var.	DF	SS	MS	F
Time	9	253.100	28.122	1.487
Replica	3	445.300	148.433	7.847**
Time X Replica	27	510.700	18.915	
Total	39	1209.100		

**significant at the 1% level

APPENDIX TABLE 59. ANALYSIS OF VARIANCE OF MALES FOR DATA TAKEN SIX MILES NORTH OF CORVALLIS, MAY 2-3, 1973.

Source of Var.	DF	SS	MS	F
Time	9	65.600	7.289	1.302
Replica	3	176.300	58.767	10.494**
Time X Replica	27	151.200	5.600	
Total	39	393.100		

**significant at the 1% level

APPENDIX TABLE 60. ANALYSIS OF VARIANCE OF FEMALES FOR DATA TAKEN SIX MILES NORTH OF CORVALLIS, MAY 2-3, 1973

Source of Var.	DF	SS	MS	F
Time	9	76.00	8.444	0.878
Replica	3	78.200	26.067	2.709
Time X Replica	27	259.800	9.622	
Total	39	414.000		

APPENDIX TABLE 61. CORRELATION COEFFICIENTS OF MALE PLUS FEMALE DATA TAKEN SIX MILES NORTH OF CORVALLIS, MAY 2-3, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	0.3418	0.1168
Temp. daylight	No. of adults	0.4075	0.1661
Temp. dark	No. of adults	0.9930	0.9861
Light intensity	No. of adults	0.2198	0.0483

APPENDIX TABLE 62. CORRELATION COEFFICIENTS OF MALE DATA TAKEN SIX MILES NORTH OF CORVALLIS, MAY 2-3, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	0.1725	0.0297
Temp. daylight	No. of males	0.1450	0.0210
Temp. dark	No. of males	1.0000	1.0000
Light intensity	No. of males	0.2099	0.0441

APPENDIX TABLE 63. CORRELATION COEFFICIENTS OF FEMALE DATA TAKEN SIX MILES NORTH OF CORVALLIS, MAY 2-3, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	0.4636	0.2149
Temp. daylight	No. of females	0.5948	0.3538
Temp. dark	No. of females	0.9631	0.9276
Light intensity	No. of females	0.2060	0.0424

APPENDIX TABLE 64. RAW DATA FROM EXPERIMENT CONDUCTED FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973

Time (PDT)	Temp.	Light intensity	Number of Adult Alfalfa Weevils											
			Block A			Block B			Block C			Block D		
			♂	♀	old[1]	♂	♀	old	♂	♀	old	♂	♀	old
7:00 AM	14.0°C	750 f.c.	14	19	2	22	19	0	8	3	0	11	9	2
10:00 AM	24.0°C	5000 f.c.	3	5	2	0	5	1	2	2	0	1	1	1
1:00 PM	28.5°C	6500 f.c.	1	0	0	3	1	1	1	1	1	1	0	0
4:00 PM	32.0°C	5750 f.c.	1	1	2	0	0	0	0	1	0	1	2	1
7:00 PM	29.0°C	3000 f.c.	5	3	1	10	6	2	4	5	0	3	1	0
8:00 PM	25.5°C	800 f.c.	9	14	0	11	12	1	11	8	0	4	9	0
9:00 PM	21.0°C	120 f.c.	25	23	1	27	28	2	12	33	3	14	13	0
10:00 PM	21.0°C	0 f.c.	44	50	3	41	34	0	24	25	2	27	23	1
1:00 AM	17.0°C	0 f.c.	29	32	1	51	34	1	18	14	1	16	19	0
4:00 AM	14.0°C	0 f.c.	19	21	1	29	52	1	21	20	0	16	22	0
5:00 AM	13.5°C	20 f.c.	25	30	2	30	29	2	13	12	2	10	15	2
6:00 AM	12.0°C	250 f.c.	19	23	0	13	12	0	10	13	1	6	9	1

[1] old refers to overwintered individuals; all others are of the new generation.

APPENDIX TABLE 65. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF ALL ADULTS CAPTURED DURING EACH TIME INTERVAL FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
7:00 AM	109	39.78%	c d
10:00 AM	23	8.39%	e
1:00 PM	10	3.64%	e
4:00 PM	9	3.28%	e
7:00 PM	40	14.59%	d e
8:00 PM	79	28.83%	d e
9:00 PM	181	66.05%	b
10:00 PM*	274	100.00%	a
1:00 AM*	216	78.83%	a b
4:00 AM*	202	73.72%	b
5:00 AM	172	62.77%	b c
6:00 AM	107	39.05%	c d

*dark

APPENDIX TABLE 66. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF NEW GENERATION MALES PLUS FEMALES CAPTURED DURING EACH TIME INTERVAL FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
7:00 AM	105	39.17%	c d
10:00 AM	19	7.08%	e f
1:00 PM	8	2.98%	f
4:00 PM	6	2.23%	f
7:00 PM	37	13.80%	e f
8:00 PM	78	29.10%	d e
9:00 PM	175	65.29%	b
10:00 PM*	268	100.00%	a
1:00 AM*	213	79.47%	a b
4:00 AM*	200	74.62%	b
5:00 AM	164	61.19%	b c
6:00 AM	105	39.17%	c d

*dark

APPENDIX TABLE 67. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF NEW GENERATION MALES CAPTURED DURING EACH TIME INTERVAL ON JUNE 20-21, 1973, FOUR MILES SOUTHEAST OF CORVALLIS.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
7:00 AM	55	40.44%	c d e
10:00 AM	6	4.41%	f
1:00 PM	6	4.41%	f
4:00 PM	2	1.47%	f
7:00 PM	22	16.17%	e f
8:00 PM	35	25.73%	e f
9:00 PM	78	57.35%	c d
10:00 PM*	136	100.00%	a
1:00 AM*	114	83.82%	a b
4:00 AM*	85	62 50%	b c
5:00 AM	78	57.35%	c d
6:00 AM	48	35 29%	d e

*dark

APPENDIX TABLE 68. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF NEW GENERATION FEMALES CAPTURED DURING EACH TIME INTERVAL FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
7:00 AM	50	37.87%	d e f
10:00 AM	13	9.84%	f g
1:00 PM	2	1.51%	g
4:00 PM	4	3.03%	g
7:00 PM	15	11.36%	e f g
8:00 PM	43	32 57%	e f g
9:00 PM	97	73.48%	a b c
10:00 PM*	132	100.00%	a
1:00 AM*	99	75.00%	a b c
4:00 AM*	115	87.12%	a b
5:00 AM	86	65 15%	b c d
6:00 AM	57	43 18%	c d e

*dark

APPENDIX TABLE 69. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF OVERWINTERED ADULTS CAPTURED DURING EACH TIME INTERVAL ON JUNE 20-21, 1973, FOUR MILES SOUTHEAST OF CORVALLIS.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test	
7:00 AM	4	50.00%	a	b
10:00 AM	4	50.00%	a	b
1:00 PM	2	25.00%		b
4:00 PM	3	37.50%	a	b
7:00 PM	3	37.50%	a	b
8:00 PM	1	12.50%		b
9:00 PM	6	75.00%	a	b
10:00 PM*	6	75.00%	a	b
1:00 AM*	3	37.50%	a	b
4:00 AM*	2	25.00%		b
5:00 AM	8	100.00%	a	
6:00 AM	2	25.00%		b

*dark

APPENDIX TABLE 70. ANALYSIS OF VARIANCE OF ALL ADULTS FOR DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

Source of Var.	DF	SS	MS	F
Time	11	22118.229	2010.748	16.954**
Replica	3	3429.396	1143.132	9.638**
Time X Replica	33	3913.853	118.602	
Total	47	29461.479		

**significant at the 1% level

APPENDIX TABLE 71. ANALYSIS OF VARIANCE OF NEW GENERATION MALES PLUS FEMALES FOR DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

Source of Var.	DF	SS	MS	F
Time	11	21609.417	1964.493	17.180**
Replica	3	3322.917	1107.639	9.686**
Time X Replica	33	3773.583	114.351	
Total	47	28705.917		

**significant at the 1% level

APPENDIX TABLE 72. ANALYSIS OF VARIANCE OF NEW GENERATION MALES FOR DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

Source of Var.	DF	SS	MS	F
Time	11	5311.667	482.879	16.066**
Replica	3	889.167	296.389	9.861**
Time X Replica	33	991.833	30.056	
Total	47	7192.667		

**significant at the 1% level

APPENDIX TABLE 73. ANALYSIS OF VARIANCE OF NEW GENERATION FEMALES FOR DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

Source of Var.	DF	SS	MS	F
Time	11	5725.729	520.521	11.413**
Replica	3	789.229	263.076	5.768**
Time X Replica	33	1505.021	45.607	
Total	47	8019.979		

**significant at the 1% level

APPENDIX TABLE 74. ANALYSIS OF VARIANCE OF OVERWINTERED ADULTS FOR DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

Source of Var.	DF	SS	MS	F
Time	11	11.667	1.061	1.469
Replica	3	2.167	0.722	1.000
Time X Replica	33	23.833	0.722	
Total	47	37.667		

APPENDIX TABLE 75. CORRELATION COEFFICIENTS OF NEW GENERATION MALE PLUS FEMALE DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	-0.6365	0.4052
Temp. daylight	No. of adults	-0.7497	0.5620
Temp. dark	No. of adults	0.9639	0.9291
Light intensity	No. of adults	-0.8417	0.7085

APPENDIX TABLE 76. CORRELATION COEFFICIENTS OF NEW GENERATION MALE DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	-0.6042	0.3650
Temp. daylight	No. of males	-0.7659	0.5866
Temp. dark	No. of males	0.9870	0.9742
Light intensity	No. of males	-0.8171	0.6677

APPENDIX TABLE 77. CORRELATION COEFFICIENTS OF NEW GENERATION FEMALE DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	-0.6555	0.4297
Temp. daylight	No. of females	-0.7284	0.5306
Temp. dark	No. of females	0.5839	0.3408
Light intensity	No. of females	-0.8485	0.7200

APPENDIX TABLE 78. CORRELATION COEFFICIENTS OF OVERWINTERED ADULT DATA TAKEN FOUR MILES SOUTHEAST OF CORVALLIS, JUNE 20-21, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	-0.2670	0.0713
Temp. daylight	No. of adults	-0.4309	0.1857
Temp. dark	No. of adults	0.9803	0.9610
Light intensity	No. of adults	-0.2972	0.0883

APPENDIX TABLE 79. RAW DATA FROM EXPERIMENT CONDUCTED AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

Time (PDT)	Temp.	Light intensity	Number of Adult Weevils [1]							
			Block A		Block B		Block C		Block D	
			♂	♀	♂	♀	♂	♀	♂	♀
12:00 PM	26.5°C	7000 f. c.	25	29	25	24	26	15	30	20
3:00 PM	27.0°C	5500 f. c.	21	25	22	17	14	8	23	15
6:00 PM	25.5°C	3000 f. c.	27	24	20	18	7	9	21	19
8:00 PM	23.0°C	200 f. c.	18	31	19	12	15	14	12	25
9:00 PM	21.0°C	1 f. c.	27	23	17	21	17	21	30	24
10:00 PM	19.5°C	0 f. c.	20	23	25	24	18	19	23	19
1:00 AM	15.5°C	0 f. c.	20	13	5	6	11	9	27	12
4:00 AM	13.0°C	0 f. c.	21	19	12	16	27	16	27	10
5:00 AM	13.5°C	0 f. c.	27	27	20	15	20	17	26	17
6:00 AM	14.5°C	150 f. c.	21	25	23	17	13	17	14	18
7:00 AM	14.0°C	350 f. c.	30	26	18	18	25	12	32	15
9:00 AM	18.0°C	4500 f. c.	21	25	23	17	13	17	14	18

[1] only overwintered adults were present

APPENDIX TABLE 80. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF MALES PLUS FEMALES CAPTURED DURING EACH TIME INTERVAL AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
12:00 PM	194	100.00%	a
3:00 PM	145	74.74%	b c
6:00 PM	145	74.74%	b c
8:00 PM	146	75.25%	b c
9:00 PM*	180	92.78%	a b
10:00 PM*	171	88.14%	a b
1:00 AM*	103	53.09%	c
4:00 AM*	148	76.28%	b
5:00 AM	169	87.11%	a b
6:00 AM	148	76.28%	b
7:00 AM	176	90.72	a b
9:00 AM	148	76.28%	b

*dark

APPENDIX TABLE 81. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF MALES CAPTURED DURING EACH TIME INTERVAL AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
12:00 PM	106	100.00%	a
3:00 PM	80	75.47%	a b c d
6:00 PM	75	70.75%	a b c d
8:00 PM	64	60.37%	c d
9:00 PM*	91	85.84%	a b c d
10:00 PM*	86	81.13%	a b c d
1:00 AM*	63	59.43%	d
4:00 AM*	87	82.07%	a b c d
5:00 AM	93	87.73%	a b c
6:00 AM	71	66.89%	b c d
7:00 AM	105	99.05%	a b
9:00 AM	71	66.89%	b c d

*dark

APPENDIX TABLE 82. TOTAL NUMBER, PERCENTAGE, AND SIGNFICANCE OF FEMALES CAPTURED DURING EACH TIME INTERVAL AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
12:00 PM	88	98.87%	a
3:00 PM	65	73.03%	b c
6:00 PM	70	78.65%	a b c
8:00 PM	82	92.13%	a b c
9:00 PM*	89	100.00%	a
10:00 PM*	85	95.50%	a b
1:00 AM*	40	44.94%	d
4:00 AM*	61	68.53%	c
5:00 AM	76	85.39%	a b c
6:00 AM	77	86.51%	a b c
7:00 AM	71	79.77%	a b c
9:00 AM	77	86.51%	a b c

*dark

APPENDIX TABLE 83. ANALYSIS OF VARIANCE OF MALES PLUS FEMALES FOR DATA TAKEN AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

Source of Var.	DF	SS	MS	F
Time	11	1539.229	139.930	3.394**
Replica	3	1619.063	539.688	13.089**
Time X Replica	33	1360.688	41.233	
Total	47	4518.979		

**significant at the 1% level

APPENDIX TABLE 84. ANALYSIS OF VARIANCE OF MALES FOR DATA TAKEN AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

Source of Var.	DF	SS	MS	F
Time	11	580.667	52.788	1.967
Replica	3	332.167	110.722	4.125*
Time X Replica	33	885.833	26.843	
Total	47	1798.667		

*significant at the 5% level

APPENDIX TABLE 85. ANALYSIS OF VARIANCE OF FEMALES FOR DATA TAKEN AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

Source of Var.	DF	SS	MS	F
Time	11	513.729	46.703	3.926**
Replica	3	608.729	202.910	17.059**
Time X Replica	33	392.521	11.895	
Total	47	1514.979		

**significant at the 1% level

APPENDIX TABLE 86. CORRELATION COEFFICIENTS OF MALE PLUS FEMALE DATA TAKEN AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	0.1795	0.0322
Temp. daylight	No. of adults	-0.0924	0.0085
Temp. dark	No. of adults	0.6624	0.4389
Light intensity	No. of adults	0.2071	0.0429

APPENDIX TABLE 87. CORRELATION COEFFICIENTS OF MALE DATA TAKEN AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	-0.0166	0.0003
Temp. daylight	No. of males	-0.1196	0.0143
Temp. dark	No. of males	0.3928	0.1543
Light intensity	No. of males	0.1838	0.0338

APPENDIX TABLE 88. CORRELATION COEFFICIENTS OF FEMALE DATA TAKEN AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	0.3418	0.1168
Temp. daylight	No. of females	0.1346	0.0181
Temp. dark	No. of females	0.7810	0.6100
Light intensity	No. of females	0.0188	0.0004

Appendix Table 89. Raw data from experiment conducted at the Union experiment station, July 12-13, 1973

Time (PDT)	Temp.	Light intensity	Number of Adult Weevils															
			Block A				Block B				Block C				Block D			
			new[1]		old[2]		new		old		new		old		new		old	
			♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
12:00 PM	27.0°C	7000 f. c.	0	0	7	4	0	0	4	3	0	0	1	4	0	0	0	2
3:00 PM	29.0°C	6000 f. c.	0	0	2	5	0	0	1	5	0	1	2	2	0	0	1	4
6:00 PM	26.5°C	3500 f. c	0	1	9	7	1	3	3	4	3	2	3	8	2	1	1	5
8:00 PM	20.5°C	400 f. c.	24	26	8	17	21	20	9	14	23	25	4	9	36	36	3	11
9:00 PM	18.0°C	5 f. c.	32	31	11	9	39	41	10	12	44	53	7	16	55	66	4	6
10:00 PM	17.0°C	0 f. c	34	49	9	10	29	27	3	7	45	41	6	9	85	87	2	9
1:00 AM	9.5°C	0 f. c	30	20	4	5	14	22	4	10	40	34	3	11	36	41	2	16
4:00 AM	9.5°C	0 f. c.	35	37	11	10	19	27	4	5	47	36	5	10	65	56	1	4
5:00 AM	8.0°C	33 f. c.	24	22	5	12	23	15	4	11	51	39	6	10	42	29	2	13
6:00 AM	8.0°C	450 f. c.	20	18	5	8	10	6	0	9	23	24	5	10	18	22	1	4
7:00 AM	14.5°C	1500 f. c.	8	5	15	10	6	5	5	5	4	7	3	10	8	4	2	5
9:00 AM	23.0°C	5000 f. c.	1	1	10	4	1	0	3	9	1	0	1	8	0	0	0	2

[1] new generation adults

[2] overwintered adults

APPENDIX TABLE 90. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF OVERWINTERED PLUS NEW GENERATION ADULTS CAPTURED DURING EACH TIME INTERVAL AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
12:00 PM	25	5.53%	e
3:00 PM	23	5.08%	e
6:00 PM	53	11.72%	e
8:00 PM	286	63.27%	b c
9:00 PM	436	96.46%	a
10:00 PM*	452	100.00%	a
1:00 AM*	292	64.60%	b c
4:00 AM*	372	82.30%	a b
5:00 AM	308	68.14%	b
6:00 AM	183	40.48%	c d
7:00 AM	102	22.56%	d e
9:00 AM	41	9.07%	e

*dark

APPENDIX TABLE 91. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF MALE PLUS FEMALE NEW GENERATION ADULTS CAPTURED DURING EACH TIME INTERVAL AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
12:00 PM	0	0%	e
3:00 PM	1	0.25%	e
6:00 PM	13	3.27%	d e
8:00 PM	211	53.14%	a b c d e
9:00 PM	361	90.93%	a
10:00 PM*	397	100.00%	a
1:00 AM*	237	59.69%	a b c d
4:00 AM*	322	81.11%	a b
5:00 AM	245	61.71%	a b c
6:00 AM	141	35.51%	b c d e
7:00 AM	47	11.83%	c d e
9:00 AM	4	1.00%	e

*dark

APPENDIX TABLE 92. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF NEW GENERATION MALES CAPTURED DURING EACH TIME INTERVAL AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
12:00 PM	0	0%	f
3:00 PM	0	0%	f
6:00 PM	6	3.10%	f
8:00 PM	104	53.88%	c d
9:00 PM	170	88.08%	a b
10:00 PM*	193	100.00%	a
1:00 AM*	120	62.17%	b c d
4:00 AM*	166	86.01%	a b
5:00 AM	140	72.53%	a b c
6:00 AM	71	36.78%	d e
7:00 AM	26	13.47%	e f
9:00 AM	3	1.55%	f

*dark

APPENDIX TABLE 93. TOTAL NUMBER, PERCENTAGE, AND SIGNFICANCE OF NEW GENERATION FEMALES CAPTURED DURING EACH TIME INTERVAL AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test				
12:00 PM	0	0%					e
3:00 PM	1	0.49%					e
6:00 PM	7	3.43%					e
8:00 PM	107	52.45%		b	c		
9:00 PM	191	93.62%	a				
10:00 PM*	204	100.00%	a				
1:00 AM*	117	57.53%		b	c		
4:00 AM*	156	76.47%	a	b			
5:00 AM	105	51.47%		b	c		
6:00 AM	70	34.31%			c	d	
7:00 AM	21	10.29%				d	
9:00 AM	1	0.49%					e

*dark

APPENDIX TABLE 94. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF OVERWINTERED MALES PLUS FEMALES CAPTURED DURING EACH TIME INTERVAL AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Time (PDT)	Total captured	% of greatest no, at any one time	Results of Duncan's NMR Test
12:00 PM	25	33.33%	d
3:00 PM	22	29.33%	d
6:00 PM	40	53.33%	b c d
8:00 PM	75	100.00%	a
9:00 PM	75	100.00%	a
10:00 PM*	55	73.33%	a b c
1:00 AM*	55	73.33%	a b c
4:00 AM*	50	66.66%	b c
5:00 AM	63	84.00%	a b
6:00 AM	42	56.00%	b c d
7:00 AM	55	73.33%	a b c
9:00 AM	37	49.33%	c d

*dark

APPENDIX TABLE 95. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF OVERWINTERED MALES CAPTURED DURING EACH TIME INTERVAL AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
12:00 PM	12	37.50%	b c
3:00 PM	6	18.75%	c
6:00 PM	16	50.00%	b c
8:00 PM	24	75.00%	a b
9:00 PM	32	100.00%	a
10:00 PM*	20	62.50%	a b c
1:00 AM*	13	40.62%	b c
4:00 AM*	21	65.62%	a b
5:00 AM	17	53.12%	b c
6:00 AM	11	34.37%	b c
7:00 AM	25	78.12%	a b
9:00 AM	14	43.75%	b c

*dark

APPENDIX TABLE 96. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF OVERWINTERED FEMALES CAPTURED DURING EACH TIME INTERVAL ON JULY 12-13, 1973 AT THE UNION EXPERIMENT STATION.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
12:00 PM	13	25.49%	e
3:00 PM	16	31.37%	e
6:00 PM	24	47.05%	c d e
8:00 PM	51	100.00%	a
9:00 PM	43	84.31%	a b
10:00 PM*	35	68.62%	a b c d
1:00 AM*	42	82.35%	a b c
4:00 AM*	29	56.86%	b c d e
5:00 AM	46	90.19%	a b
6:00 AM	31	60.78%	b c d e
7:00 AM	30	58.82%	b c d e
9:00 AM	23	45.09%	d e

*dark

APPENDIX TABLE 97. ANALYSIS OF VARIANCE OF OVERWINTERED PLUS NEW GENERATION ADULTS FOR DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Source of Var.	DF	SS	MS	F
Time	11	73137.729	6648.884	19.183**
Replica	3	4484.063	1494.688	4.313**
Time X Replica	33	11437.688	346.697	
Total	47	89059.479		

**significant at the 1% level

APPENDIX TABLE 98. ANALYSIS OF VARIANCE OF NEW GENERATION MALES PLUS FEMALES FOR DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Source of Var.	DF	SS	MS	F
Time	11	62058.729	5641.703	18.294**
Replica	3	6118.729	2039.576	6.616**
Time X Replica	33	10177.021	308.395	
Total	47	78354.479		

**significant at the 1% level

APPENDIX TABLE 99. ANALYSIS OF VARIANCE OF NEW GENERATION MALES FOR DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Source of Var.	DF	SS	MS	F
Time	11	15279.063	1389.006	15.728**
Replica	3	1641.896	547.299	8.197**
Time X Replica	33	2914.354	88.314	
Total	47	19835.313		

**significant at the 1% level

APPENDIX TABLE 100. ANALYSIS OF VARIANCE OF NEW GENERATION FEMALES FOR DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Source of Var.	DF	SS	MS	F
Time	11	15988.667	1453.515	18.233**
Replica	3	1430.333	476.778	5.981**
Time X Replica	33	2630.667	79.717	
Total	47	20049.667		

**significant at the 1% level

APPENDIX TABLE 101. ANALYSIS OF VARIANCE OF OVERWINTERED MALES PLUS FEMALES FOR DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Source of Var.	DF	SS	MS	F
Time	11	808.250	73.477	4.815**
Replica	3	395.417	131.806	8.637**
Time X Replica	33	503.583	15.260	
Total	47	1707.250		

**significant at the 1% level

APPENDIX TABLE 102. ANALYSIS OF VARIANCE OF OVERWINTERED MALES FOR DATA TAKEN AT THE UNION EXPERIMENT STATION JULY 12-13, 1973.

Source of Var.	DF	SS	MS	F
Time	11	141.729	12.884	2.825*
Replica	3	255.229	85.076	18.652**
Time X Replica	33	150.521	4.561	
Total	47	547.479		

**significant at the 1% level

*significant at the 5% level

APPENDIX TABLE 103. ANALYSIS OF VARIANCE OF OVERWINTERED FEMALES FOR DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Source of Var.	DF	SS	MS	F
Time	11	390.729	35.521	4.526**
Replica	3	3122.917	10.410	1.326
Time X Replica	33	259.021	7.849	
Total	47	680.979		

**significant at the 1% level

APPENDIX TABLE 104. CORRELATION COEFFICIENTS OF OVERWINTERED PLUS NEW GENERATION DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	-0.6105	0.3727
Temp. daylight	No. of adults	-0.5746	0.3302
Temp. dark	No. of adults	0.9042	0.8176
Light intensity	No. of adults	-0.8561	0.7329

APPENDIX TABLE 105. CORRELATION COEFFICIENTS OF NEW GENERATION MALE PLUS FEMALE DATA TAKEN JULY 12-13, 1973, AT THE UNION EXPERIMENT STATION.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	-0.5957	0.3549
Temp. daylight	No. of adults	-0.5703	0.3253
Temp. dark	No. of adults	0.8474	0.7181
Light intensity	No. of adults	-0.8309	0.6903

APPENDIX TABLE 106. CORRELATION COEFFICIENTS OF NEW GENERATION FEMALE DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	-0.5498	0.3023
Temp. daylight	No. of females	-0.5134	0.2636
Temp. dark	No. of females	0.8943	0.7998
Light intensity	No. of females	-0.8118	0.6590

APPENDIX TABLE 107. CORRELATION COEFFICIENTS OF NEW GENERATION MALE DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	-0.6382	0.4073
Temp. daylight	No. of males	-0.6214	0.3861
Temp. dark	No. of males	0.7821	0.6117
Light intensity	No. of males	-0.8440	0.7124

APPENDIX TABLE 108. CORRELATION COEFFICIENTS OF OVERWINTERED MALE PLUS FEMALE DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	-0.5072	0.2573
Temp. daylight	No. of adults	-0.5331	0.2842
Temp. dark	No. of adults	0.5000	0.2500
Light intensity	No. of adults	-0.8333	0.6949

APPENDIX TABLE 109. CORRELATION COEFFICIENTS OF OVERWINTERED MALE DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	-0.2321	0.0539
Temp. daylight	No. of males	-0.2884	0.0832
Temp. dark	No. of males	0.3974	0.1579
Light intensity	No. of males	-0.5792	0.3355

APPENDIX TABLE 110. CORRELATION COEFFICIENTS OF OVERWINTERED FEMALE DATA TAKEN AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	-0.5897	0.3478
Temp. daylight	No. of females	-0.6166	0.3802
Temp. dark	No. of females	-0.0443	0.0020
Light intensity	No. of females	-0.8496	0.7219

APPENDIX TABLE 111. RAW DATA FROM EXPERIMENT CONDUCTED AT THE REDMOND EXPERIMENT STATION, MAY 16-17, 1973.

Time (PDT)	Light intensity	Temp.	Number of Adult Weevils							
			Block A		Block B		Block C		Block D	
			♂	♀	♂	♀	♂	♀	♂	♀
6:00 PM	1600 f. c.	26.5°C	0[1]	1	0	1	0	0	0	5
8:00 PM	450 f. c.	25.5°C	0	0	0	1	3	3	1	3
9:00 PM	1 f. c.	21.5°C	2	5	3	10	15	21	3	13
10:00 PM	0 f. c.	20.0°C	7	16	2	10	14	21	7	15
1:00 AM	0 f. c.	17.5°C	1	5	1	4	4	3	2	5
4:00 AM	0 f. c.	10.5°C	0	3	0	3	3	6	5	1
5:00 AM	2 f. c.	9.0°C	0	0	0	1	0	0	1	0
6:00 AM	225 f. c	7.5°C	0	0	0	0	0	2	0	0
7:00 AM	1600 f. c.	13.5°C	0	0	0	0	1	2	1	3
10:00 AM	5000 f. c.	21.5°C	0	0	0	0	0	2	0	1
1:00 PM	6000 f. c.	26.0°C	0	1	1	0	0	1	1	2
4:00 PM	6000 f. c.	28.0°C	0	0	2	0	0	2	1	1

[1] only overwintered individuals were present

APPENDIX TABLE 112. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF OVERWINTERED MALES PLUS FEMALES CAPTURED DURING EACH TIME INTERVAL AT REDMOND EXPERIMENT STATION, MAY 16-17, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
6:00 PM	7	7.60%	b
8:00 PM	11	11.95%	b
9:00 PM*	72	78.26%	a
10:00 PM*	92	100.00%	a
1:00 AM*	25	27.17%	b
4:00 AM*	21	22.82%	b
5:00 AM*	2	2.17%	b
6:00 AM	2	2.17%	b
7:00 AM	7	7.60%	b
10:00 AM	3	3.26%	b
1:00 PM	6	6.25%	b
4:00 PM	6	6.25%	b

*dark

APPENDIX TABLE 113. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF OVERWINTERED MALES CAPTURED DURING EACH TIME INTERVAL AT THE REDMOND EXPERIMENT STATION, MAY 16-17, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
6:00 PM	0	0%	b
8:00 PM	4	13.33%	b
9:00 PM*	23	76.66%	a
10:00 PM*	30	100.00%	a
1:00 AM*	8	26.66%	b
4:00 AM*	8	26.66%	b
5:00 AM*	1	3.33%	b
6:00 AM	0	0%	b
7:00 AM	2	6.66%	b
10:00 AM	0	0%	b
1:00 PM	2	6.66%	b
4:00 PM	3	10.00%	b

*dark

APPENDIX TABLE 114. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF OVERWINTERED FEMALES CAPTURED DURING EACH TIME INTERVAL AT THE REDMOND EXPERIMENT STATION, MAY 16-17, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test		
6:00 PM	7	11.29%		b	c
8:00 PM	7	11.29%		b	c
9:00 PM*	49	79.03%	a		
10:00 PM*	62	100.00%	a		
1:00 AM*	17	27.41%		b	
4:00 AM*	13	20.96%		b	c
5:00 AM*	1	1.61%			c
6:00 AM	2	3.22%		b	c
7:00 AM	5	8.06%		b	c
10:00 AM	3	4.83%		b	c
1:00 PM	4	6.45%		b	c
4:00 PM	3	4.83%		b	c

*dark

APPENDIX TABLE 115. ANALYSIS OF VARIANCE OF MALES PLUS FEMALES FOR DATA TAKEN AT THE REDMOND EXPERIMENT STATION, MAY 16-17, 1973.

Source of Var.	DF	SS	MS	F
Time	11	2411.417	219.220	11.986**
Replica	3	226.917	75.639	4.135*
Time X Replica	33	603.583	18.290	
Total	47	3241.917		

** significant at the 1% level
* significant at the 5% level

APPENDIX TABLE 116. ANALYSIS OF VARIANCE OF MALES FOR DATA TAKEN AT THE REDMOND EXPERIMENT STATION MAY 16-17, 1973.

Source of Var.	DF	SS	MS	F
Time	11	261.063	23.733	4.575**
Replica	3	52.063	17.354	3.345*
Time X Replica	33	171.188	5.188	
Total	47	484.313		

**significant at the 1% level
*significant at the 5% level

APPENDIX TABLE 117. ANALYSIS OF VARIANCE OF FEMALES FOR DATA TAKEN AT THE REDMOND EXPERIMENT STATION, MAY 16-17, 1973.

Source of Var.	DF	SS	MS	F
Time	11	1092.729	99.339	17.404**
Replica	3	62.386	20.799	3.644*
Time X Replica	33	188.354	5.708	
Total	47	1343.479		

**significant at the 1% level
*significant at the 5% level

APPENDIX TABLE 118. CORRELATION COEFFICIENTS OF MALE PLUS FEMALE DATA TAKEN AT THE REDMOND EXPERIMENT STATION, MAY 16-17, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	0.0952	0.0091
Temp. daylight	No. of adults	0.5314	0.2824
Temp. dark	No. of adults	0.8614	0.7419
Light intensity	No. of adults	-0.4097	0.1679

APPENDIX TABLE 119. CORRELATION COEFFICIENTS OF MALE DATA TAKEN AT THE REDMOND EXPERIMENT STATION, MAY 16-17, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	0.0775	0.0060
Temp. daylight	No. of males	0.4190	0.1756
Temp. dark	No. of males	0.8429	0.7096
Light intensity	No. of males	-0.4032	0.1626

APPENDIX TABLE 120. CORRELATION COEFFICIENTS OF FEMALE DATA TAKEN AT THE REDMOND EXPERIMENT STATION MAY 16-17, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	0.0960	0.0092
Temp. daylight	No. of females	0.2509	0.0629
Temp. dark	No. of females	0.8696	0.7562
Light intensity	No. of females	-0.4137	0.1712

APPENDIX TABLE 121. RAW DATA FROM EXPERIMENT CONDUCTEDTWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Time (PDT)	Light intensity	Temp.	Number of Adult Weevils											
			Block A			Block B			Block C			Block D		
			♂[1]	♀[1]	old[2]	♂	♀	old	♂	♀	old	♂	♀	old
10:00 AM	5000 f. c.	18.0°C	1	0	0	1	0	1	1	2	0	0	1	1
1:00 PM	6300 f. c.	27.5°C	0	1	0	0	1	0	1	0	1	2	0	0
4:00 PM	5500 f. c.	29.0°C	0	0	0	3	0	0	0	1	2	0	0	1
7:00 PM	1500 f. c.	25.0°C	2	3	0	1	1	2	8	5	0	3	2	0
8:00 PM	500 f. c.	22.0°C	6	7	1	1	2	1	5	6	0	9	6	0
9:00 PM	5 f. c.	22.0°C	16	11	0	17	12	0	23	26	1	25	22	1
10:00 PM	0 f. c.	15.0°C	52	49	1	61	44	1	43	37	0	29	26	0
1:00 AM	0 f. c.	12.5°C	53	33	1	29	28	0	30	25	2	65	62	1
4:00 AM	0 f. c.	7.0°C	16	5	0	13	8	3	34	20	1	16	9	3
5:00 AM	2 f. c.	6.0°C	12	6	0	7	6	0	3	2	0	3	2	1
6:00 AM	160 f. c.	6.0°C	1	1	0	3	1	0	3	1	0	2	2	1
7:00 AM	1500 f. c.	10.5°C	1	2	0	0	1	0	1	1	0	0	0	0

[1] new generation

[2] overwintered generation

APPENDIX TABLE 122. TOTAL NUMBER, PERCENTAGE AND SIGNIFICANCE OF OVERWINTERED PLUS NEW GENERATION ADULTS CAPTURED DURING EACH TIME INTERVAL ON JULY 24-25, 1973, TWO MILES NORTH OF PRINEVILLE.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	8	2.33%	c
1:00 PM	6	1.74%	c
4:00 PM	7	2.04%	c
7:00 PM	27	7.87%	c
8:00 PM	44	12.82%	c
9:00 PM	154	44.89%	b
10:00 PM*	343	100.00%	a
1:00 AM*	329	95.91%	a
4:00 AM*	128	37.31%	b
5:00 AM*	42	12.24%	c
6:00 AM	15	4.37%	c
7:00 AM	6	1.74%	c

*dark

APPENDIX TABLE 123. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF NEW GENERATION MALES PLUS FEMALES CAPTURED DURING EACH TIME INTERVAL TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	6	1.75%	d
1:00 PM	5	1.46%	d
4:00 PM	4	1.17%	d
7:00 PM	25	7.33%	d
8:00 PM	42	12.31%	c d
9:00 PM	152	44.57%	b
10:00 PM*	341	100.00%	a
1:00 AM*	325	95.30%	a
4:00 AM*	121	35.48%	b c
5:00 AM*	41	12.02%	c d
6:00 AM	14	4 10%	d
7:00 AM	6	1.75%	d

*dark

APPENDIX TABLE 124. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF NEW GENERATION MALES CAPTURED DURING EACH TIME INTERVAL TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	3	1.62%	c
1:00 PM	3	1.62%	c
4:00 PM	3	1.62%	c
7:00 PM	14	7.56%	c
8:00 PM	21	11.35%	c
9:00 PM	81	43.78%	b
10:00 PM*	185	100.00%	a
1:00 AM*	177	95.67%	a
4:00 AM*	79	42.70%	b
5:00 AM*	25	13.51%	c
6:00 AM	9	4 86%	c
7:00 AM	2	1.10%	c

*dark

APPENDIX TABLE 125. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF NEW GENERATION FEMALES CAPTURED DURING EACH TIME INTERVAL TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	3	1.92%	c
1:00 PM	2	1.28%	c
4:00 PM	1	0.64%	c
7:00 PM	11	7.05%	c
8:00 PM	21	13.46%	c
9:00 PM	71	45.51%	b
10:00 PM*	156	100.00%	a
1:00 AM*	148	94.87%	a
4:00 AM*	42	26.92%	b c
5:00 AM*	16	10.25%	c
6:00 AM	5	3.20%	c
7:00 AM	4	2.56%	c

*dark

APPENDIX TABLE 126. TOTAL NUMBER, PERCENTAGE, AND SIGNIFICANCE OF OVERWINTERING GENERATION ADULTS CAPTURED DURING EACH TIME INTERVAL TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Time (PDT)	Total captured	% of greatest no. at any one time	Results of Duncan's NMR Test
10:00 AM	2	28.57%	b
1:00 PM	1	14.28%	b
4:00 PM	3	42.85%	a b
7:00 PM	2	28.57%	b
8:00 PM	2	28.57%	b
9:00 PM	2	28.57%	b
10:00 PM*	2	28.57%	b
1:00 AM*	4	57.14%	a b
4:00 AM*	7	100.00%	a
5:00 AM*	1	14.28%	b
6:00 AM	1	14.28%	b
7:00 AM	0	0%	b

*dark

APPENDIX TABLE 127. ANALYSIS OF VARIANCE OF OVERWINTERED PLUS NEW GENERATION ADULTS FOR DATA TAKEN TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Source of Var.	DF	SS	MS	F
Time	11	42084.729	3825.884	19.808**
Replica	3	103.729	34.576	0.179
Time X Replica	33	6374.021	193.152	
Total	47	48562.479		

**significant at the 1% level

APPENDIX TABLE 128. ANALYSIS OF VARIANCE OF NEW GENERATION MALES PLUS FEMALES FOR DATA TAKEN TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Source of Var.	DF	SS	MS	F
Time	11	41617.417	3783.402	19.744**
Replica	3	106.917	35.639	0.186
Time X Replica	33	6323.583	191.624	
Total	47	48047.917		

**significant at the 1% level

APPENDIX TABLE 129. ANALYSIS OF VARIANCE OF NEW GENERATION MALES FOR DATA TAKEN TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Source of Var.	DF	SS	MS	F
Time	11	12382.417	1125.674	19.136**
Replica	3	26.250	8.750	0.149
Time X Replica	33	1941.250	58.826	
Total	47	14349.917		

**significant at the 1% level

APPENDIX TABLE 130. ANALYSIS OF VARIANCE OF NEW GENERATION FEMALES FOR DATA TAKEN TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Source of Var.	DF	SS	MS	F
Time	11	8679.500	789.045	17.739**
Replica	3	36.667	12.222	0.275
Time X Replica	33	1467.833	44.480	
Total	47	10184.000		

**Significant at the 1% level

APPENDIX TABLE 131. ANALYSIS OF VARIANCE OF OVERWINTERED ADULTS FOR DATA TAKEN TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

Source of Var.	DF	SS	MS	F
Time	11	9.063	0.824	1.429
Replica	3	1.729	0.576	1.000
Time X Replica	33	19.021	0.576	
Total	47	29.813		

APPENDIX TABLE 132. CORRELATION COEFFICIENTS OF NEW GENERATION MALE PLUS FEMALE DATA TAKEN TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	-0.2116	0.0448
Temp. daylight	No. of adults	0.1125	0.0127
Temp. dark	No. of adults	0.9738	0.9482
Light intensity	No. of adults	-0.5149	0.2652

APPENDIX TABLE 133. CORRELATION COEFFICIENTS OF NEW GENERATION MALE DATA TAKEN TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of males	-0.2474	0.0612
Temp. daylight	No. of males	0.1159	0.0134
Temp. dark	No. of males	0.9633	0.9279
Light intensity	No. of males	-0.5246	0.2753

APPENDIX TABLE 134. CORRELATION COEFFICIENTS OF NEW GENERATION FEMALE DATA TAKEN TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of females	-0.1788	0.0320
Temp. daylight	No. of females	0.1109	0.0123
Temp. dark	No. of females	0.9802	0.9609
Light intensity	No. of females	-0.5009	0.2509

APPENDIX TABLE 135. CORRELATION COEFFICIENTS OF OVERWINTERED ADULT DATA TAKEN TWO MILES NORTH OF PRINEVILLE, JULY 24-25, 1973.

X variable	Y variable	R value	R^2 value
Temp. all times	No. of adults	-0.1289	0.0166
Temp. daylight	No. of adults	0.6633	0.4399
Temp. dark	No. of adults	-0.1965	0.0386
Light intensity	No. of adults	-0.1873	0.0351

APPENDIX TABLE 136. WIND VELOCITIES AND NUMBER OF WEEVILS CAPTURED AT DIFFERENT SAMPLING TIMES AT THE UNION EXPERIMENT STATION, JUNE 6-7, 1973.

Time (PDT)	Ave. wind velocity	"Max." wind velocity	No. of adults
12:00 PM	5 mph	8 mph	194
3:00 PM	0 mph	0 mph	145
6:00 PM	6 mph	9 mph	145
8:00 PM	3 mph	8 mph	146
9:00 PM	4.5 mph	6 mph	180
10:00 PM	2.5 mph	2.5 mph	171
1:00 AM	3 mph	5 mph	103
4:00 AM	0 mph	0 mph	148
5:00 AM	0 mph	0 mph	169
6:00 AM	0 mph	0 mph	148
7:00 AM	0 mph	0 mph	176
9:00 AM	3 mph	3 mph	148

APPENDIX TABLE 137. WIND VELOCITIES AND THE NUMBER OF WEEVILS CAPTURED AT DIFFERENT SAMPLING TIMES AT THE UNION EXPERIMENT STATION, JULY 12-13, 1973.

Time (PDT)	Ave. wind velocity	"Max." wind velocity	No. of adults
12:00 PM	9 mph	11 mph	25
3:00 PM	10 mph	15 mph	23
6:00 PM	7 mph	10 mph	53
8:00 PM	4 mph	6 mph	286
9:00 PM	4 mph	5 mph	436
10:00 PM	4 mph	6 mph	452
1:00 AM	0 mph	0 mph	292
4:00 AM	0 mph	0 mph	372
5:00 AM	0 mph	0 mph	308
6:00 AM	0 mph	0 mph	183
7:00 AM	0 mph	0 mph	102
9:00 AM	8 mph	10 mph	41

APPENDIX TABLE 138. CORRELATION COEFFICIENTS FOR WIND VELOCITY DATA TAKEN AT THE UNION EXPERIMENT STATION, JUNE 6-7 AND JULY 12-13, 1973.

Date	X variable	Y variable	R value	R^2 value
June 6-7	Max. wind vel.	No. of adults	0.0150	0.0002
June 6-7	Ave. wind vel.	No. of adults	0.0943	0.0089
July 12-13	Max. wind vel.	No. of adults	-0.5602	0.3138
July 12-13	Ave. wind vel.	No. of adults	-0.5776	0.3337