Controlling the pecan nut casebearer by applying insecticide based on heat units

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Fig. 1 Adult pecan nut casebearer. *

The pecan nut casebearer (fig. 1) over winters as a small larva in a cocoon attached to a dormant pecan bud. When the bud breaks dormancy, the larva grows and develops by feeding on the buds and then on the growing shoot. The major damage from the pecan nut casebearer occurs when the first summer generation feeds on the small nutlets.

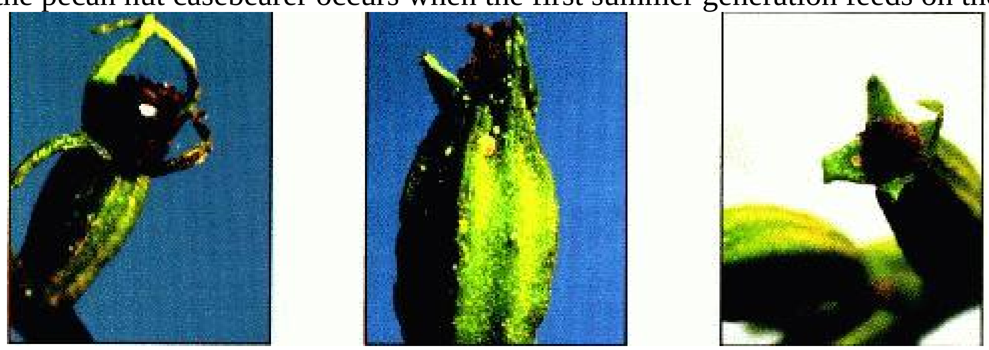

Fig. 2 Pecan nut casebearer egg on stigma, side of nutlet and bract of nutlet. *

The development of the pecan nutcase bearer like any biological organism responds to its thermal environment, which is especially critical to "cold blooded" insects because their internal temperatures are dictated by the surrounding environment. If the environmental temperature exceeds some upper limit or declines below some lower limit, growth and development are impaired or halted fig. 3. However, when these organisms are exposed to temperatures within some optimal range, growth and development typically increase with temperature. Heat units or growing degree days quantify an organism's thermal environment providing a daily estimate of the amount of contributory heat -- heat that will contribute to growth and development.

The pecan nut casebearer can be controlled by applying a pesticide at the proper time when the adult emergence occurs. For determining the optimal time to apply the pesticide, growing degree days are calculated by accumulating heat units that occur each day in the optimal thermal range.

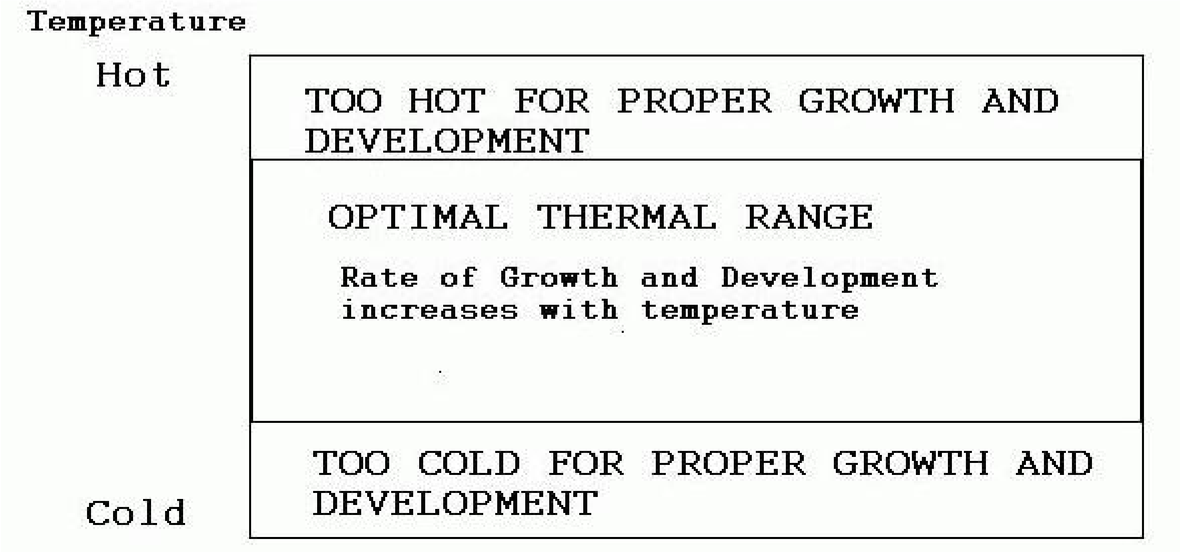

Figure 3. Hypothetical response of a cold-blooded biological organism to temperature

The heat unit concept uses the daily temperature information along with knowledge about the pecan nut casebearer's thermal limits to quantify the contributory heat. Fig. 4 shows a typical temperature cycle with a pecan nut casebearer base line thermal limit superimposed on the diagram.

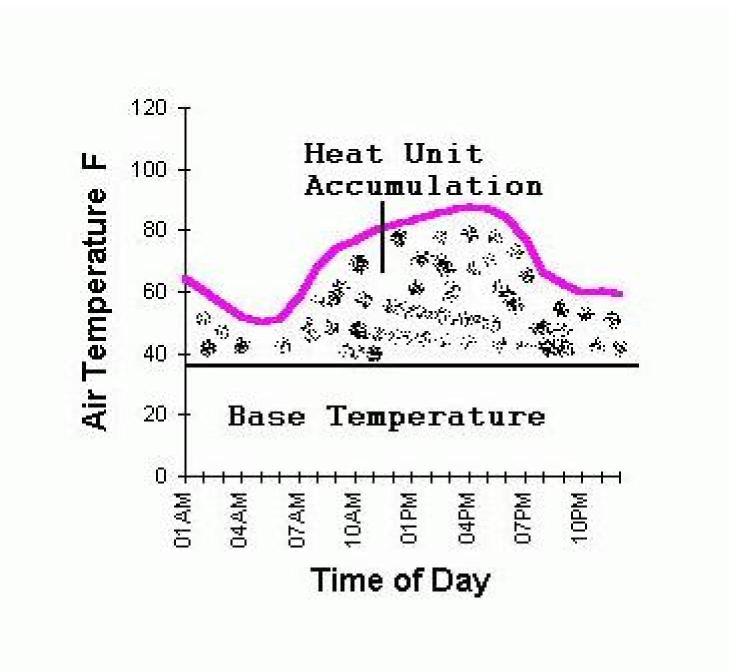

Figure 4. A typical daily temperature cycle for Las Cruces, New Mexico

As can be observed for the pecan nut casebearer there is no upper limit that stops growth and development. If the temperature falls below the baseline, the heat units become negative and are subtracted from the positive heat units during the rest of the day. The concept is that the negative heat units have to be made up before additional growth occurs . With most insect models, the base temperature and the lower cutoff temperature are the same so no negative heat units can occur. However, when information is lacking on how cold temperature during the early part of the day effects the insect development, then no lower cutoff temperature is used. If the heat unit total for the day is negative, then the daily total is set to zero.

Because hourly temperature data is not usually available, the hourly temperature is reconstructed by forcing a sine curve through the daily maximum and minimum temperatures fig. 5.

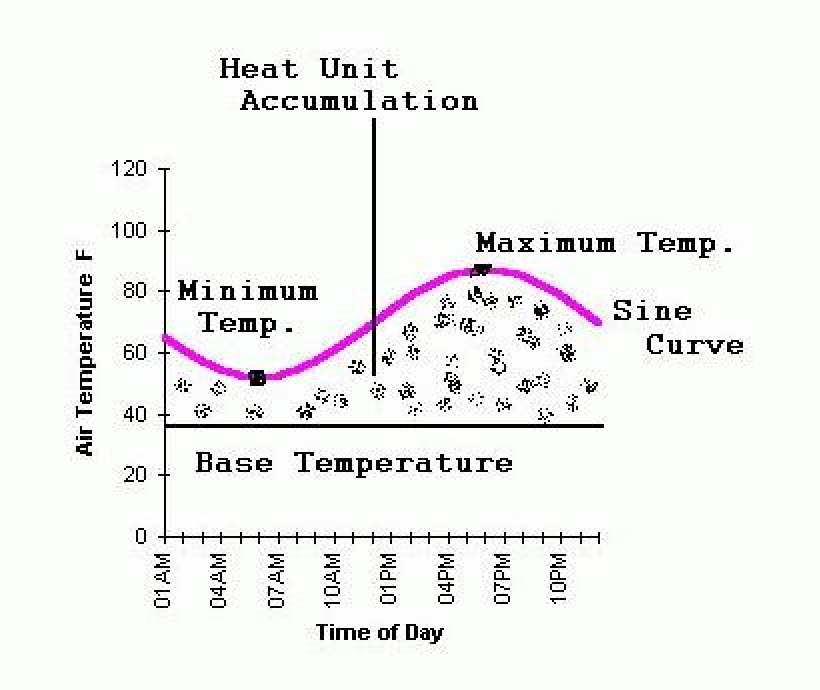

Figure 5. The sine curve method of calculating heat units reconstructs a daily temperature cycle by forcing a sine curve through the daily maximum and minimum temperatures.

During non-cloudy days, the temperature curve approaches a sine curve in shape and using the daily maximum and minimum temperatures results in a satisfactory estimated of the daily heat units. During cloudy days, some error will occur using this method. Because the sine curve is symmetrical, the growing degree days can be calculated using an average method given by equation 1:

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Gdd=(Maximum temperature + minimum temperature)/2 - base temperature            (1)
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As can be observed in fig. 5, the base temperature is 38F and there are no maximum or minimum cutoff temperatures.

Next determine when the pecan nut casebearer starts to develop so that growing degree days can start accumulating. The pecan nut casebearer becomes active breaking diapause in the spring when bud break occurs. Consequently, Jackman and Harris(1988) recommend beginning growing degree accumulation 10 days before 50% bud break. A second method used to initiate the start of degree day accumulation is to identify the starting date of the first frost in the fall and use eq. 2:

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Start Date =(Ffd-266/2.72) + 71,                                                  (2)
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where:

Ffd
: is Julian day of the first fall frost

If the computed starting date is less than Julian day 65, use day 65 or March 6 as the starting date. For Las Cruces, the first frost occurs on Oct. 25 or Julian Date 298 and the starting date is:

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Start Date =(298-266/2.72)+71 = 82 = March 23
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Jackman and Harris (1988) developed the number of degree days to describe the pecan nut casebearer life cycle. (table 1). When the degree day total reaches 1730-1760, inspect the pecans by examining 10 nut clusters/tree for eggs or nut entries. Each egg and nut entry is counted as an infested cluster and if two infested clusters are found before having examined 400 cluster (40 tress), treat for pecan nut casebearer. If no infested clusters are found, sample again on the day when 1810 degree days are reached and follow the same procedure. If none are found sample two days later, and if still none are found, there is probably no need to spray.

Calculating growing degree days using the weather internet site.

Go to the page http://weather.nmsu.edu/map/map.htm and fill out the form. The computer form will ask for the climate station you want to use to calculate growing degree days. Select the station from the list or from the maps. Select auto data and then change the starting date to the correct date. Select Pecans for a crop and the the upper and lower temperature limits will be set. Change the base temperature to be 38 F which is appropriate for the Pecan pecan nut casebearer
Then press the retrieve weather data button

Reference

J. A. Jackman and M. K. Harris, 1988 Managing the Pecan Nut Casebearer by Predicting Timing of Insecticide Spraying Using a Computer program. Western Pecan Conference Proceedings (22nd),pp. 15-25

* Pictures were copied from "Controlling the Pecan Nut Casebearer" by Allen Knutson and Bill Ree Texas Agricultural Extension publication

Protocol for pecan nut casebearer pheronome trapping program.