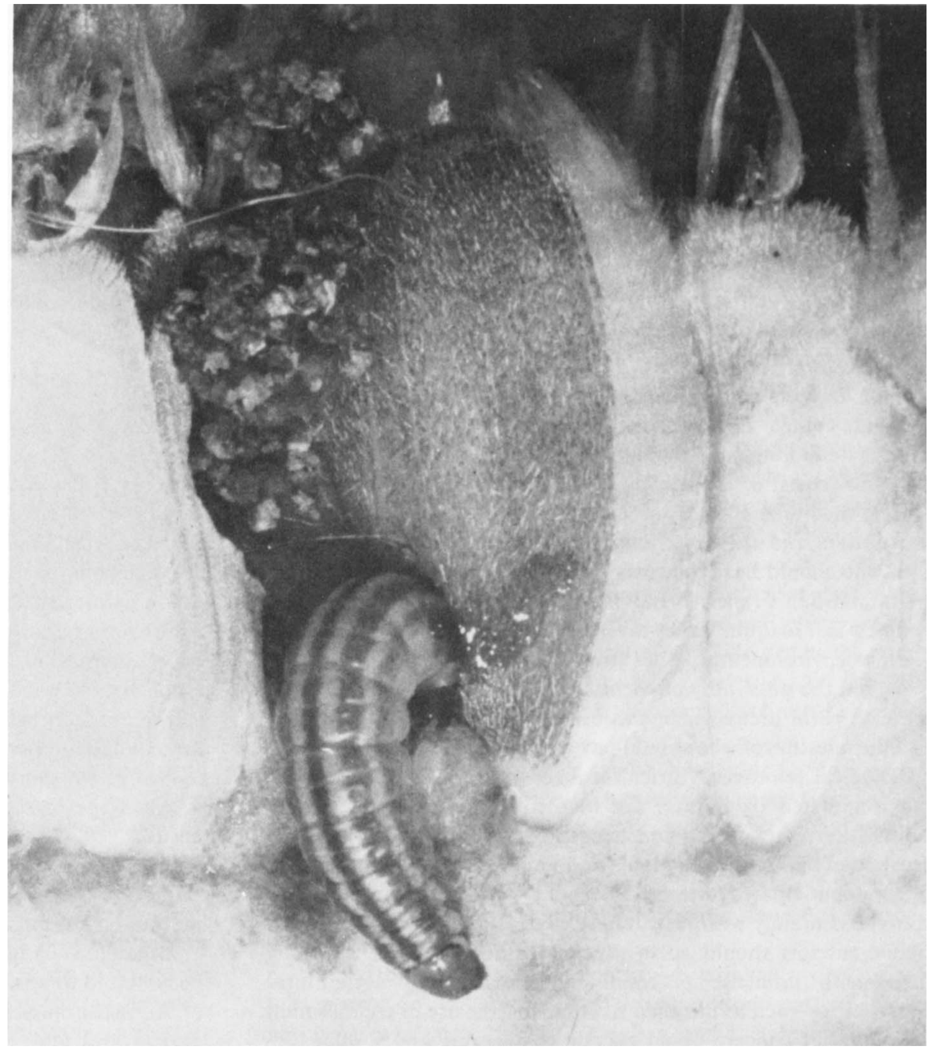

Fig. 1. Sunflower moth larva feeding on sunflower seed.

Tracing the flight activity of the sunflower moth

Elmer C. Carlson □ Robert L. Witt □ Jeffrey C. Miller

The sunflower moth, *Homoeosoma electellum* (Hulst.) is the principal pest of commercially grown sunflowers, *Helianthus annuus L.* Adult female moths typically oviposit on and among the disk flowers or florets at the periphery of the developing inflorescence at the onset of bloom. Larvae (fig. 1) develop through five instars, initially feeding on pollen and florets and ultimately on mature seeds. In northern California, one larva damages or destroys an average of nine seeds. Economic losses may occur when population densities exceed 12 larvae per flower head. Yields of sunflower seed have been reduced 30 to 60 percent in years of high sunflower moth infestation.

Three insecticides, endosulfan, methidathion, and methyl parathion, are registered for control of sunflower moth larvae. Field evaluations of alternative insecticides were conducted during 1976 and 1977. Insecticides were initially applied when sunflowers were at 20 to 25 percent bloom. A second application followed five to seven days later. Damage to seed heads was assessed 21 and 28 days after treatment. Larval damage, as shown by the clumps of frass and webbing in each flower head, was categorized by degree of severity, with (1) representing no damage and (5) severe damage. (See table.)

A seed damage index was also determined by selecting 500 seeds from each treatment and scoring them from (1) to (4), (4) being the most severely damaged. (See table.)

Three insecticides, Pydrin (SD 43775), Orthene (acephate), and Ambush (permethrin), were assessed (see table). A comparison of control and insecticide treatments in 1976 revealed that Pydrin provided a significant reduction in field and seed damage. In 1977, applications of Pydrin, Orthene, and Ambush reduced seed loss to sunflower moth significantly.

Flight activity

Flight activity of sunflower moth was monitored to establish an empirical basis for the timing of insecticide applications. The number of moths collected at four black-light sources was recorded and averaged on a weekly basis from 1966 through 1969. The data revealed that flight activity typically began in mid-July and terminated in early October. Generally, two flight peaks were observed, indicating that sunflower moth may have two generations in the Davis area. Because the moth's phenological occurrence was too irregular to be of much value in predicting flight patterns, a temperature model was constructed.

A model of flight activity was based on accumulated day degrees above a specified thermal threshold. To determine the appropriate threshold, seven temperatures (at 2-degree intervals between 48 and 60° F) were assumed to represent the temperature below which no development occurs. In accordance with each threshold variable, total day degrees were calculated from January 1 to the peak of the first flight, and from the peak of the first flight to the peak of the second flight. The sum of day degrees was calculated from the maximum and minimum temperature data for each day. The appropriate developmental threshold was then determined by comparing each assumed threshold to the standard deviation (SD) of the total day degrees per flight interval, calculated from respective thresholds over the four-year period (fig. 2). The minimum SD indicates the starting threshold that best fits the field data. For each flight interval, a 56° F threshold provided the most consistent average of accumulated day degrees. Therefore, 56°F may be assumed to represent the threshold temperature that provides the most accurate prediction of the total day degrees required from January 1 to respective flight peaks.

When plotted on an accumulated day-degree basis, the flight activity of the sunflower moth had a first peak close to 2005 day degrees (+ 83 SD), with a second peak approximately 543 day degrees (+ 90 SD) later (fig. 3). These data provide a means for predicting the peaks of moth populations and flight activity in the field. Thus, the monitoring of population levels and the implementation of control measures may be timed on the basis of temperature data.

In recent years, considerable research has been conducted, in cooperation with plant breeders and biochemists, to gather additional information on the nature of resistance to feeding larvae. The presence of an "armored" (phytomelanin) layer in the sunflower seed coat is correlated with the mechanism of resistance and at least two diterpenoid acids, found in the florets and seeds, make the plant resistant to larval feeding. Other research has revealed that the resistance trait is carried by a single dominant gene.

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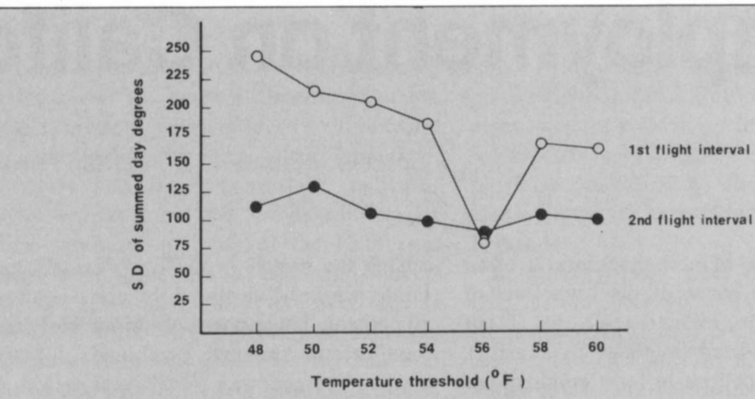

FIG. 2. Standard deviation (S D) of the summed day degrees between peak flights of *Homoeosoma electellum*, Davis, California 1966-1969.

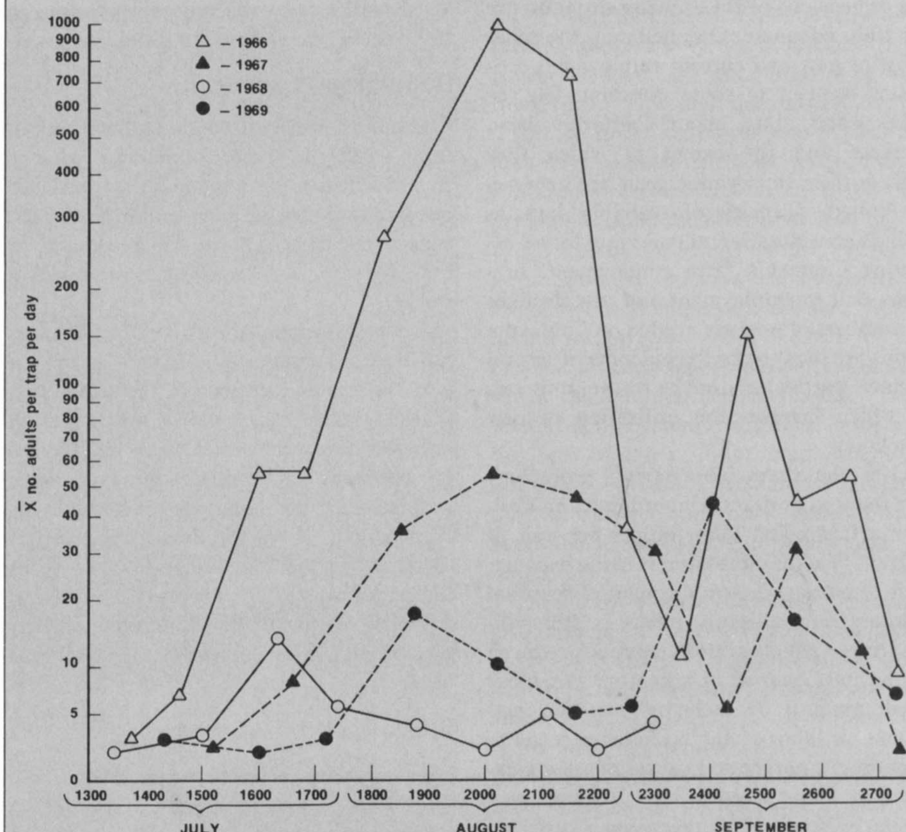

FIG. 3. Average number of adult *Homoeosoma electellum* caught per trap per day.

Estimates of Sunflower Seed and Head Damage Caused by Sunflower Moth — Davis 1976 and 1977

Year	Treatment*	Field damage index†	Seed damage index‡
1976	Pydrin	0.21 a§	1.3 a
	control	1.21 b	31.5 b
1977	Orthene	0.18 a	10.3 a
	Ambush	0.10 a	12.3 a
	Pydrin	0.35 a	13.5 a
	control	1.84 b	154.3 b

* All chemicals were applied at 1 pound AI/acre.

† Damage to seed heads: (1) no evidence of larval feeding, (2) one feeding scar and webbing, (3) two to three feeding scars, (4) four to six feeding scars, (5) three-fourths or more of the head covered with frass and webbing.

‡ Based on 500 seeds from twenty sunflower heads of equal size from each of four replicates of each treatment: (1) no evidence of damage, (2) slight damage, (3) moderate to severe damage, (4) complete or nearly complete destruction of the seed.

§ Estimates not having a letter in common are significantly different at the 5% level of probability (Duncan's multiple range test).