Control of Sunflower Moth Larvae

Investigations on the control of the sunflower moth, *Homoeosoma electellum* (Hulst), conducted over several seasons indicated that certain insecticides can satisfactorily reduce sunflower head and seed damage when multiple applications are properly timed. Of the commercially available materials tested, endosulfan and diazinon afforded the most efficient control. Treatments must begin at onset of bloom, and three applications at intervals of 5 to 7 days gave optimum results. Two applications were the minimum required, but three were generally needed because of the fast head growth, quick flowering, and concentrated egg deposition during this period. The biological agent *Bacillus thuringiensis*, was found unsatisfactory for control. Only GS 13005 (of several new experimental chemicals tested) gave outstanding control. One larva could severely damage nine or more seeds, and moderate to severe infestations of 12 to 24 larvae per head caused serious seed loss. Pesticide control was usually necessary, but the actual amount of damage varied from season to season.

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SUNFLOWERS have been grown as a minor crop in California since 1931, with the acreage fluctuating between 3,000 and 8,000 acres. Large-seeded types have been grown, with a preference for the varieties Greystripe (also called Russian Lightstripe, Mammoth Russian, or Russian Greystripe) and Black Manchurian. The seed has been used mostly for human consumption, reaching the market with or without the hulls after salting and

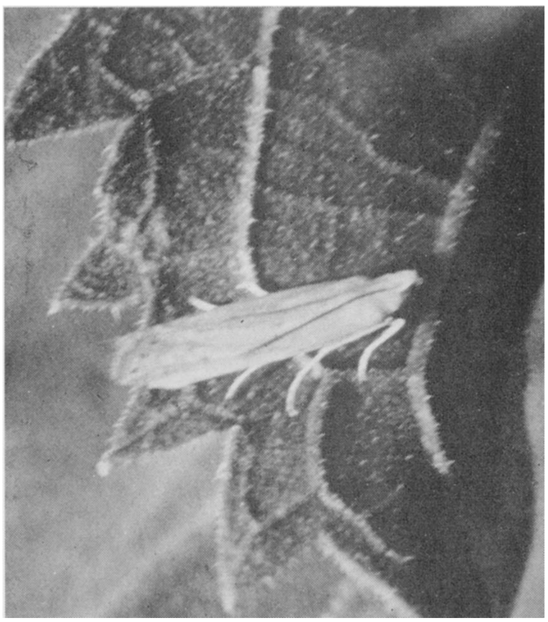


TABLE 1. REDUCTION OF SUNFLOWER MOTH DAMAGE TO SUNFLOWER HEADS AND SEEDS BY INSECTICIDAL TREATMENTS, DAVIS. CALIFORNIA, 1965*

Treatments and amounts per acre (actual)	Index of severity of head damage	Reduction of head damage %	Worm-damaged seeds/500 No.	Yield of seed	
				Ounces per head	Pounds per acre
GS 13005, 1 lb.[1]	0.87 a	82	4 a	3.09 a	3361
Endosulfan, 1 lb.	1.52 b	69	10 a	2.98 ab	3242
Diazinon, 1½ lb.	2.26 c	54	33 ab	2.81 abc	3057
Endosulfan, 1 lb.[2]	2.53 c	48	50 b	2.61 cd	2839
Abate, 1 lb.[3]	2.99 d	39	55 b	2.74 bc	2981
Biotrol 2.5D, 56.75[4] Trillion Spores	3.32 d	32	103 c	2.51 cde	2731
Trichlorfon, 1½ lb.	3.78 e	23	111 c	2.37 de	2578
Thuricide, 130[4] Trillion Spores	3.92 ef	20	168 d	2.19 ef	2382
Thuricide, 65[4] Trillion Spores	4.16 f	15	191 d	2.22 ef	2415
Check, Untreated	4.88 g	—	255 e	1.92 f	2089

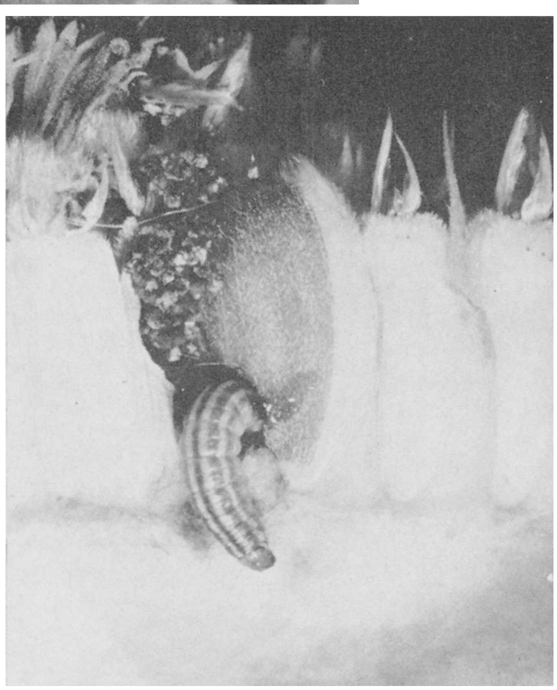
* Spraying was begun at onset of bloom, August 11, 1965, and repeated on August 14 and 20. Those treatment means not having a subletter in common are significantly different at the 5% level.

[1] 0,0-dimethyl phosphorodithioate S-ester with 4-(mercaptomethyl)-2-methoxy Δ^2-1,3,4-thiadiazolin-5-one.

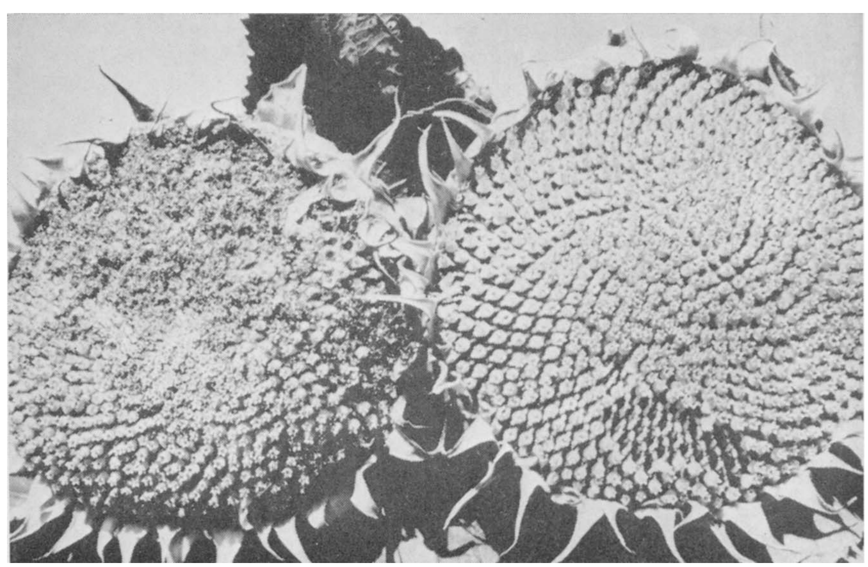
[2] This treatment was sprayed only on August 11 and 14.

[3] 0,0-dimethyl phosphorothioate 0,0-diester with 4,4′-thiodiphenol phosphorothioate.

[4] *Bacillus thuringiensis* Berliner.



Above left, sunflower moth adult at rest on leaf. Below left, larval damage to sunflower seed. Below right, sunflower head on left in photo shows weblike material and frass resulting from larval feeding, as compared with normal head to right.



and Damage to Sunflower Seeds

roasting. The smaller seeds have gone into the feed industry as a part of poultry scratch. There has been some recent interest in small-seeded types for use as a source of oil, when produced from new dwarf selections of sunflowers. This interest may develop further to fill the need of local industries for additional crops to process for oil, and because of the availability of more land due to the curtailment of cotton acreage.

There are many insect pests of sunflowers in California, the most serious of which is the sunflower moth, *Homoeosoma electellum* (Hulst), shown resting in the photo on a sunflower leaf. The purpose of this investigation was to formulate a program for controlling this pest—including a determination of the chemical residues involved through using the most promising pesticides tested, and the determination of the economic levels of damage from the feeding of this pest.

Bionomics

The eggs are laid among the disc flowers. Larvae hatched from these bore into developing seeds and weblike material and granular frass are first observed in the peripheral areas of the heads soon after flowering (see photos). The mature larvae are about 5/8 to 3/4 of an inch long, are yellowish-green beneath, and have five brown to black dorsal longitudinal stripes. Each larva bores into and damages an average of about nine seeds within approximately a three week period. When population densities are high, seed losses per head often reach 30 to 60 per cent and occasionally 100 per cent, especially on the weaker, small heads. In northern California, pupation occurs only in the soil. The mature larvae lower themselves to the soil on a strand of silk, crawl into the soil through available cracks, spin cocoons, and pupate.

Mature larva of sunflower moth, to left, showing brown to black dorsal stripes.

The test materials for chemical control experiments were applied with a CO_2-powered back pack sprayer equipped with a twin-nozzle boom and Teejet 800067 flat-fan tips. Treatments consisted of one, two, or three applications and were replicated five times. Some plants were sprayed first at the onset of bloom, others just after bloom. The sunflowers used in these investigations were an inbred strain (selection No. 5 of the Department of Agronomy, University of California, Davis). This strain grows about 5½ ft high, has uniformly large heads and seeds, and a strong stalk.

The severity of larval damage to the seed heads was determined at four different intervals after treatments. Each "spot" of damage on a seed head consisted of a fairly discrete clump of webbing and frass, and the number of such clumps per seed head was determined on each inspection date and scored according to five class values. The seed yields were computed on a per head basis, and 20 heads per replicate were carefully selected for size uniformity. The seeds were stripped and cleaned from the dry heads. Five hundred seeds were picked at random from each lot for determinations of worm damage and weight yield. Subsamples of 100 seeds were then reserved for germination tests and for evaluations of seed size.

Populations of sunflower moths were low during the first seasons of 1962 and 1963. However, the results indicated the advantage of beginning treatments at onset of bloom, and the increased control afforded by two applications versus one—especially with the insecticides endosulfan and diazinon.

Larvae of the sunflower moth reached a density of about 12 per seed head during 1964. Counts showed that each larva fed on, and damaged or destroyed, an average of 9.24 seeds. This level of infestation and seed loss was regarded as serious. Data from the control trials showed that three applications of endosulfan at 1 lb of actual chemical per acre produced excellent larval control. Two applications of endosulfan or diazinon (1½ lbs) beginning at onset of bloom also resulted in satisfactory control. These three treatments also permitted an increase in the size and number of good seeds and the total yield. One application of these materials gave unsatisfactory moth control and resulted in little yield increase.

High level infestations observed during 1965 produced about 50% damaged seeds. A sequence of three treatments containing GS 13005 (table 1) resulted in only four damaged seeds per 500 seeds. This reduction in seed damage was judged superior control, although not significantly better than the reduction afforded by three applications of endosulfan or diazinon. Reductions in damage were not as great with two applications of endosulfan or with the three sprayings of Abate. Less satisfactory control was obtained with the biological agents (Thuricide and Biotrol) or trichlorfon. The superior treatments resulted in an increase in yield and size of seeds.

The data obtained during 1966 (table 2) confirm the excellent results previously

TABLE 2. REDUCTION OF SUNFLOWER MOTH DAMAGE TO SUNFLOWER HEADS AND SEEDS BY INSECTICIDAL TREATMENTS, DAVIS, CALIFORNIA, 1966*

Treatments and amounts per acre (actual)	Index of severity of head damage	Reduction of head damage %	Worm-damaged seeds/500 No.	Yield of seeds: Ounces per head	Yield of seeds: Pounds per acre
GS 13005, 1 lb.	1.0 a	78	8.0 a	2.48 a	2698
Endosulfan, 1 lb.	1.5 ab	67	15.2 ab	2.48 a	2698
Fenthion, 1 lb.	2.3 bc	49	21.6 abc	2.37 ab	2576
Abate, 1½ lb.	2.7 cd	40	32.6 c	2.22 b	2419
Thuricide, 90 TS, 130 Trillion Spores	3.7 de	18	75.2 d	1.97 c	2141
Check, Untreated	4.5 e	—	61.8 d	1.84 c	2002

* All treatments were begun at onset of bloom, August 4, 1966, and were repeated on August 11 and 17. New chemicals given by number or trade name designations are the same as given in Table 1; and the differences required for significance are the same.

obtained with three spray applications containing GS 13005 and endosulfan. In this trial, the crop was treated three times (1 lb actual/acre) beginning at onset of bloom. Reductions in numbers of worm-damaged seeds were good, and yield increases were very significant. Sprays containing Fenthion and Abate also appeared to provide fairly satisfactory control. The Thuricide treatments were regarded as unsatisfactory.

Several pesticides were tested in 1967 for sunflower moth control in a commercial seed field of sunflower. Treatments were applied by aircraft. Endosulfan and GS 13005 sprays gave satisfactory reductions in severity of head damage, and also resulted in the largest percentage of uninfested heads. Endosulfan was also used as a dust and spray, but the control obtained with the dust was inferior to that obtained by the spray. Diazinon spray gave only fair larval control. The biological control agent (Biotrol 2.5D) and Azodrin were unsatisfactory in this test. The low population of moths in the field, and the low larval infestation and seed loss, permitted only a moderate increase in seed yield with endosulfan and GS 13005.

Chemical analyses have shown that single and multiple applications of endosulfan and diazinon leave identifiable residues in the mature seed. However, endosulfan now has state and Federal registration with a permissible tolerance of 2 ppm. It is now being recommended for control of sunflower moth larvae at 1 lb of active chemical per acre, since chemical residues are within the established tolerance. Three spray applications appear to be optimum, especially when insect populations are heavy. Early morning treatments do not appear to adversely affect, or repel, bee pollinators for more than a day—or to affect the seed set on the variety used.

Sunflower moths in this area do not emerge and cause head infestations until June, and are generally most serious in July and August. Therefore, it appears advantageous to plant sunflowers as early in the season as possible, and to use strains that bloom quickly, early and uniformly —prior to any significant moth emergence and larval infestation.

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The rural community and housing for families

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Four factors appearing to be associated with attitudes of community residents toward OEO-financed housing facilities for migrant farm workers and their families are: (1) type of primary source of income in the community; (2) resident property ownership; (3) distance of the housing facility from crops being harvested; and (4) distance of the facility from centers of population. Early community involvement and planning contributed greatly to creating and sustaining successful relationships within the rural area.

THE DEMISE OF THE bracero program has focused new attention on the domestic farm worker. Despite accelerated mechanization efforts, relatively large numbers of seasonal laborers will probably be required in the harvest of perishable crops for at least the next decade. To help ensure an adequate labor supply, and to improve the laborer's living conditions, the California Office of Economic Opportunity (OEO) is financing low-cost temporary housing for migratory farm workers and their families in areas that need large numbers of seasonal labor. During the past two harvest seasons, housing complexes with as many as 100 units were constructed and occupied. (According to law, such temporary housing can be occupied for a maximum of six calendar months during one year and must be capable of being dismantled at the end of such periods of occupancy.)

Community reactions to these housing facilities and their occupants have varied, and the publicity each has received appears to be related directly to the amount of negative community reaction. To learn more about the attitudes of residential communities toward the migrant housing facilities and occupants, a research project was initiated in 1966 by the Department of Applied Behavioral Sciences, University of California, Davis. The project also included a study of the migrants living in these units.

The findings summarized here are from interviews with 423 persons living in three rural California communities: one in the Sacramento Valley (community A), and two in the San Joaquin Valley (communities B and C). These communities were selected because they were near three proposed but not completed OEO migrant housing facilities, housing facilities had not previously been available for migrant farm worker families in the areas, and two of the three communities had expressed negative reactions toward having migrant housing facilities nearby.

Data on the over-all characteristics of the communities showed residents were primarily middle-class Anglo-American Protestants with a median educational level of twelfth grade. The mean taxable annual family income was approximately $7,500, ranging from a mean of $5,700 (community A) to $8,350 (community C). The majority wanted their children to graduate from college, and expected that they would. The primary source of income was reported to be wages and salaries by three-fifths of the respondents in community A, half in community B, and three-fourths in community C. Only two-fifths of the residents of community A reported owning property, compared with three-fifths in community B and one-half in community C.

Site location

The communities differed in the location of the housing site relative to the population center and the crop area. In community A the site was less than 1/4 mile from a village, and most occupants had to drive 10 to 20 miles to work (only a few perishable crops were grown nearby). In community B, the site was 2½ miles from the nearest population center but within an area with a high need for seasonal labor. In community C, the site was about 1½ miles from the nearest population center and also 10 to 25 miles from the area of employment. In communities B and C the sites were