Pesticides for controlling sunflower moth larvae

E. C. CARLSON

Satisfactory reduction of sunflower head and seed damage by the sunflower moth, **Homoeosoma electellum** (Hulst), was afforded by carbofuran at both 1 and 2 lb AI/acre, but seed weight per head was significantly increased only by the 2 lb dosage. A miscible formulation of methyl parathion at 1 lb AI/acre resulted in satisfactory reduction of seed damage and an increase in seed weight. An encapsulated formulation of this pesticide was not as satisfactory for control and did not significantly increase seed weight. Methomyl resulted in good reduction of damage, but did not significantly increase yields. Dipel (HD-1 strain of **Bacillus thuringiensis** Berliner var. **kurstaki** de Barjac and Lemille) was unsatisfactory for control. Methidathion at ½ lb AI/acre and at two applications afforded very good sunflower moth control, reduction of seed damage, and significant increase in seed weight per head.

Photo 1. Sunflower moth on sunflower leaf.

INCREASED INTEREST in pesticides to control the sunflower moth, *Homoeosoma electellum* (Hulst) (photo 1), has gradually evolved during the past 20 years. The first pesticide to be approved for use against the larvae (photo 2) on sunflowers in California was endosulfan with a tolerance of 0.5 ppm. Soon after, several other pesticides were tested for potential use on this crop. Of these, only methyl parathion has been registered and made available to producers of sunflower seeds (except in California where the residue in the seeds remains too high). The quest for effective new materials continues because the need persists.

Seven different pesticides were tested on sunflowers of the variety UC 5 developed by the Department of Agronomy and Range Science, University of California, Davis. This is an inbred variety which blooms early and uniformly at a height of approximately 5½ ft. It is one of the varieties very susceptible to attack by larvae of the sunflower moth.

These trials were conducted at Davis during a period of four years, from 1970 through 1973, and two years at Linden, California (1972–73). The test sprays were applied two or three times at intervals of 5 to 7 days during August and September. They were timed to begin when 25–50% of the plants were beginning to bloom. The small plots comprised two rows of sunflowers 25–50 ft in length, five replications per treatment, in randomized layouts. The buds and seed heads of the plants were sprayed with a backpack sprayer operating two flat-fan nozzle tips at 60 lb per sq. in., 15 sec/25-ft row; and applied at 0.5, 1.0 and 2.0 lb active ingredient/acre (AI/acre).

The severity of damage done to seed heads by sunflower moth larvae was estimated 23 to 29 days after final spraying. The amount of damage to the heads was judged on the basis of frass, web and exudate, and scored according to five class values (0, 1, 2, 3, and 4). These estimates were reduced to an "index of damage" by the equation $\Sigma fx/N$, where f = no. of heads/class, x = class value and N = no. of heads inspected. Weight of seeds produced was calculated on a per-head basis from 20 heads of uniform size picked at random within each replicate. The dry seeds (from these heads after drying) were threshed, cleaned, and weighed. Number of seeds damaged by larvae of the sunflower moth was determined from 500 seeds randomly selected from each of the above samples. In addition, seed weight was determined for the lots of 500 seeds, and viability was checked with germination tests on 100 seeds from each lot.

Aircraft sprays were applied at 12 gal/acre to 50-ft swaths approximately 2,200 ft in length. Twenty-five heads were taken from each of eight to nine substations within each plot and indexed for head damage as described for the small plot tests.

The indices of damage to seed heads in the checks indicated that the infestation was substantial in three of four trials, and that infestation in the first trial (1970) was the lowest.

Three sprays of carbofuran or Bay 93820 (0-methyl phosphoramidothioate 0-ester with isopropyl salicylate) were

unequally effective in 1970, but performance of both treatments was regarded as satisfactory according to the index of damage and the number of damaged seeds. Average weights of seed from 25 seed heads and of subsamples comprising 500 seeds were significantly higher than for equivalent check samples only in the plots sprayed with carbofuran at 2.0 lb AI/acre, rather than the sprays made at 1 lb AI/acre.

Two sequences of sprays were tested against a higher infestation of moths and an increase in index of damage during 1971. The miscible formulation of methyl parathion resulted in a significantly lower index of damage than the encapsulated form of the same pesticide, methomyl and Dipel (HD-1 strain of *Bacillus thuringiensis* Berliner var. *kurstaki* de Barjac and Lemille, 7.26×10^9 IU/lb), all at a rate of 1 lb AI/acre. Miscible methyl parathion did not significantly reduce the number of damaged seeds compared to the other pesticides, and yet it was the only material that resulted in an increase in seed weight and yield over that in the check. The level of control obtained by the Dipel sprays was judged to be inadequate.

Methidathion and phosalone were tested against a high sunflower moth infestation and a high index of damage to seed heads during 1972. Both treatments effectively and equally protected the crop of sunflower seeds and significantly increased seed weights and yields, but methidathion did so at ½ lb AI/acre rather than 1 lb.

These two pesticides were again tried under comparable field conditions, each one at two dosages in 1973. The larger amount of each material gave a better result than the small amount as judged by the index of damage. According to the number of damaged seeds, methidathion was adequate at ½ lb AI/acre, while the smaller dosage of phosalone (½ lb AI/acre) was significantly less effective and 1 lb was needed.

Methidathion and endosulfan were applied by aircraft at Linden, California, and the results judged by the index of damage to seed heads. The best of the treatments decreased worm damage about 65–78%. The multiple sprays applied during 1972 could not be separated with confidence because of low moth infestations. However, during 1973, the single applications of both methidathion and endosulfan appeared significantly less effective than multiple applications, and two sprays appeared adequate. One spray of methidathion at ½ lb AI/acre showed significant improvement over one spray of methidathion at ½ lb AI/acre showed at 1.0 lb AI/acre. Two sprays of methidathion at ½ lb AI/acre appeared satisfactory, and were not significantly less effective than either two or three sprays at 1 lb.

Residues of four pesticides were obtained from supplemental samples taken from several of the test plots. One methidathion spray at 1.0 lb AI/acre left a residue of 0.48 ppm at 1 day, 0.16 ppm at 18 days and diminished thereafter to 0.05 ppm at 67 days. A succession of three aircraft sprays of methidathion, each at 1.0 lb AI/acre, produced residues on maturing seed of 0.76 ppm 24 days after final spraying, 1.40 ppm at 38 days and, finally, 0.55 ppm after 66 days (mature seed). These analyses were performed with a GLC (FPD-phosphorus) method, sensitivity 0.01 ppm.

Two successive sprays of miscible methyl parathion applied manually at 1.0 lb AI/acre each spray left 0.39 ppm on seeds 26 days after final spraying, 0.13 ppm at 45 days and 0.25 ppm at 56 days (mature seed). An encapsulated formulation of methyl parathion yielded somewhat higher residues: 0.56 ppm at 26 days, 0.52 ppm at 45 days and 1.64 at 56 days. Residues of methyl parathion were determined by the same procedure used for methidathion. In this same trial, methomyl sprays left 0.28 ppm at 26 days but only 0.07 ppm at 45 days. The analytical procedure used for methomyl was the GLC (FPD-sulphur) method, sensitivity 0.02 ppm.

In the final trial (1973), seeds sprayed three times with phosalone, 0.5 lb AI/acre each time, contained 3.81 ppm phosalone at 40 days and 2.11 ppm at 65 days. A heavier dosage of phosalone, 1.0 lb AI/acre, three sprays, resulted in 8.58 ppm on seeds at 40 days and 2.56 ppm at 65 days. The GLC-AFID procedure, sensitivity 0.01 ppm, was used.

Germination tests were conducted using seed harvested from the small plots treated with methidathion and phosalone during 1972 and 1973. Seed germination exceeded 90% for all lots tested from 1972 trials. During the next season (1973), the checks showed 83% germination whereas seeds sprayed wiith methidathion (both dosages) showed 90% or better germination. Phosalone may have affected seed viability because seed harvested from the plot receiving the small dosage (0.5 lb AI/acre) showed only 58% germination as compared with 83% for the check.

AIRCRAFT TESTS OF TWO INSECTICIDES FOR PERFORMANCE DATA ON CONTROL OF SUNFLOWER MOTH LARVAE
LINDEN, CA 1972–1973

Materials	lb AI/acre (each applic.)	Index of damage Sept. 13, 1972	Index of damage Oct. 2, 1973
Methidathion 3 applications*	1.0	—	1.54a
Methidathion 3 applications	0.5	0.15a	1.45a
Methidathion 2 applications	0.5	0.21a	1.65a
Methidathion 1 application	0.5	0.28a	2.18b
Endosulfan 2 applications	1.0	0.23a	—
Endosulfan 1 application	1.0	—	2.79c
Check (untreated)	—	0.67b	4.10d

* The 1972 aircraft sprays were applied: No. 1 on 7/22, No. 2 on 7/28 and No. 3 on 8/3. The 1973 sprays were: No. 1 on 7/31, No. 2 on 8/6 and No. 3 on 8/16.

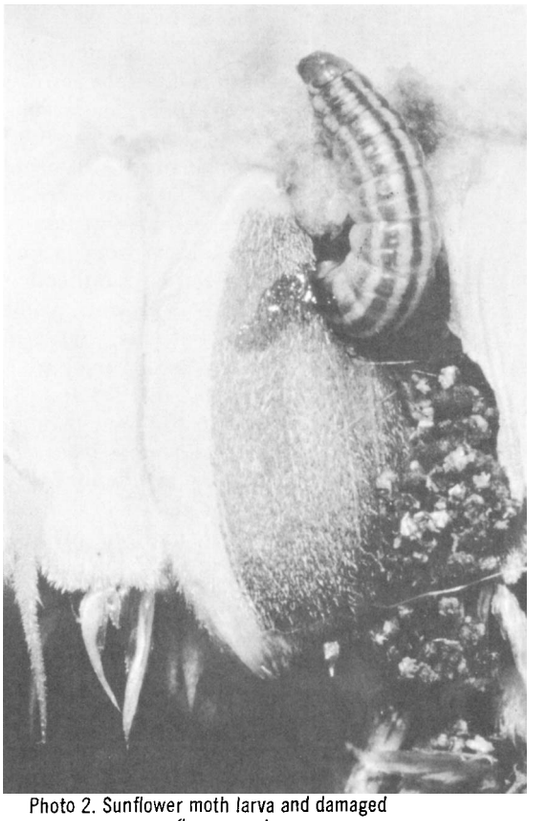

Photo 2. Sunflower moth larva and damaged sunflower seed.

In March 1975 methidathion received an EPA residue tolerance level of 0.5 ppm in or on sunflower seeds.

Elmer C. Carlson is Specialist, Department of Entomology, University of California at Davis. *Assisting in the study were John Campbell, retired nurseryman, and Robert Witt, Staff Research Associate, U.C. Davis. Wray Winterlin and his staff at the U.C. Davis Department of Environmental Toxicology conducted the chemical analyses. Franz Kegel, Farm Advisor (San Joaquin County), Daryl Bonshu of Lyng Seed Co. in Modesto, and Dale Christensen of Ciba-Geigy Agricultural Chemical Co. participated in the aircraft experiments.*