

# Artichoke Plume Moth Damage

large part of 1953-54 losses believed to be result of inadequate sanitation and cultural practices

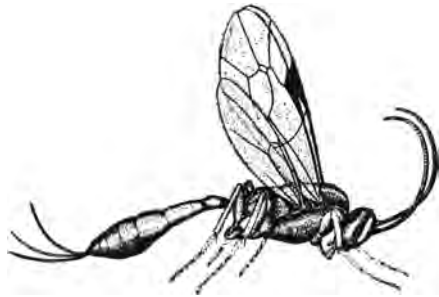
W. Harry Lange, R. H. Sciaroni, and A. S. Greathead

Successful control of the artichoke plume moth in the Half Moon Bay area during experiments in 1949 and 1950 was reported in CALIFORNIA AGRICULTURE for September, 1951.

**The artichoke plume moth**—*Platyptilia carduidactyla* (Riley)—has caused artichoke growers—in the Castroville area of Monterey County alone—estimated losses of \$300,000 during the 1953-54 season because of wormy artichokes and early closing of the packing sheds.

In 1922 and in 1936, moth damage became so severe that California growers requested aid from the University of California. Then, again in the 1952-53 and 1953-54 seasons, the losses reached major proportions, often as high as 50% to 70%.

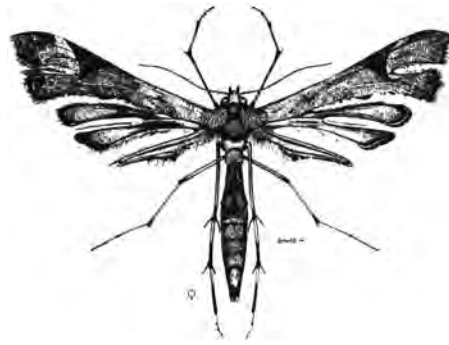
The continuous overlapping broods of the moth combined with an ever-ready



Female of the most important parasite *Angitia platyptiliae*. Greatly enlarged.

source of host plant material—artichoke—have made it possible for the moth to breed throughout the year. The staggering of plantings to obtain artichokes at different times of the year also allows moths a ready source of their favorite food plant.

The moths lay from 70 to 300 eggs—with an average of 170 eggs—on the undersides of the woolly leaves or fuzzy stems of the artichoke. In from eight to 24 days the larvae hatch and either crawl down into the center of the plants or, during the spring, directly up into the buds. If no buds are present in the centers of the plants, the small worms, after feeding on the tender, interfolded leaves, enter leaf petioles and become borers. If buds are present, the larvae enter and cause the characteristic unsightly blackened appearance of the buds. Larvae may feed from 36 to 86 days. Pupation occurs in the stems or on the outer bracts of the buds, attached by a flimsy silken



Adult of artichoke plume moth. Greatly enlarged.

net. In from 10 to 30 days the adult moths emerge. This means a variation in the time from egg to adult of from 54 to 140 days. Adults may live as long as 30 days.

## Seasonal Cycle

The plume moth has three overlapping generations a year. It is not adapted to hibernation or aestivation and for this reason must have an ever-ready source of food plant.

The Summer-Generation starts with the small plants, following the usual practice of cutting off the tops during the period of April 20 to June 15. The Summer-Generation worms are borers for the most part but can cause damage to early

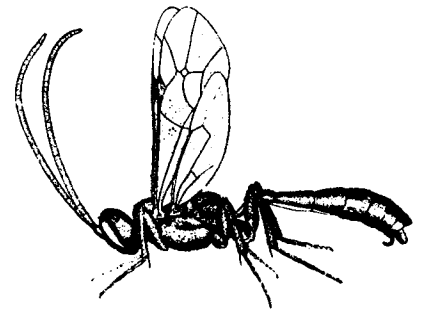
Pupation on artichokes thrown in field.



artichokes produced during July and August.

The Fall-Generation starts in September and due to cool climatic conditions may carry over to the following March. The Fall-Generation larvae cause damage to artichokes during October, November, December, January, and February.

A Spring-Generation may start in December in certain seasons and cause damage from January to June. Adults of the Spring-Generation often lay their eggs on the stems just below the buds, and the small larvae are the typical leaf miners found in the outer bracts. These larvae are often difficult to detect as they



Male of the most important parasite *Angitia platyptiliae*. Greatly enlarged.

enter the buds after the buds have almost reached maturity.

The moths also feed on thistles, particularly of the genus *Cirsium*, where there is a succession of moths on the different species.

## Natural Control

Being a native insect, larvae of the plume moth are attacked by several parasites. The most important is an ichneumon wasp—*Angitia platyptiliae* Cushman—which often parasitizes from 2% to 10% of the larvae in artichoke fields. A range in parasitism of from 2% to 90% has been recorded, but the parasites are more successful on thistles where the larvae of the moth are more exposed. Two secondary parasites of the wasp—*Dibrachys cavus* (Wlk.) and a *Gelus* sp.—reduce its effectiveness against the artichoke moth. A second primary para-

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site—of the moth—*Epiurus bicoloripes* Ashm.—and a third—*Phaeogenes* sp.—may often parasitize larvae on thistles but are less effective on artichokes.

### Chemical Control

Extensive tests during 1937-38 indicated that complete coverage sprays of rotenone and fixed nicotine gave some degree of control provided at least six applications were made. Dusts of a number of chemicals were ineffective. From 1949 to the present time, tests in San Mateo and Monterey counties again indicated that complete coverage sprays of most materials are more effective than dusts, with the exception of parathion. During the period 1949-54, parathion, and parathion plus DDT, as dusts or sprays, were the only effective materials. The following were ineffective: aldrin, dieldrin, heptachlor, endrin, isodrin, EPN, NPD, malathion, diazinon, nicotine-rotenone, and perthane. Lindane gave some degree of control but was eliminated because of possible off-flavors. Parathion apparently acts as a fumigant in addition to its contact effect, killing the small larvae.

Full coverage sprays have not proved practical because of the lack of adequate spray equipment and difficulty in entering fields with heavy equipment. Low gallonage airplane applications have not proved effective. Equipment for applying dusts is available, and a 2% parathion dust or a 2% parathion dust with 5% DDT has proved effective. It is necessary, however, to apply 45-50 pounds—two to three applications—properly timed.

The best control has been obtained in San Mateo County against the fall brood of worms, with applications on September 1-7, September 15-20, and October 1-7. Timing varies, and whether the third application can be applied depends upon the progress of the crop. It is necessary to stop applications of parathion within 15 days of harvest or DDT within 30 days of harvest. Parathion applied for the moth also controls the artichoke aphid, often a serious pest. DDT controls many other worms which occasionally attack the crop. Applications can also be made on the summer brood on June 1-7, June 15-20, and July 10-15 for early artichokes. Applications from March 1 to April 15 on the spring brood can only be used if safer chemicals can be found.

The results of the 1953 chemical applications are shown in the lower table. Chemical control was more successful at Half Moon Bay under low population levels than at Castroville where worminess increased in the checks from 38.8% to 57.1% during the duration of the test.



Mining of small larvae in bracts of artichoke buds.

The same trend showing the effectiveness of parathion and parathion-DDT is indicated.

The effects of chemicals upon parasites are not completely known, but to date, there does not seem to be any correlation between fields dusted or not dusted in relation to later worm damage.

### Residue Hazards

Residue analyses were run during a three-year period to determine possible poisonous residue hazards on artichokes. These results indicate that less than one part per million of parathion remains on the crop seven days following application. The upper table on this page shows the results of parathion residues taken in 1950 and 1953.

Because parathion is a dangerous chemical, growers and equipment opera-

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#### Results of Parathion Residue Analysis on Artichokes, 1950-53

Dust Materials	Number of Applications	Pounds Per Acre	Dates Applied	Days from Application	Parathion ppm*
Parathion 2% . . . . .	1	38.0	8/31/50	14	0.0
Parathion 2% . . . . .	1	46.6	8/31/50	14	0.0
plus DDT 5% . . . . .					0.9 (DDT)
Parathion 2% . . . . .	1	40.0	9/21/50	7	0.0
Parathion 2% . . . . .	1	48.75	9/21/50	7	0.0
plus DDT 5% . . . . .					0.9 (DDT)
Parathion 2% . . . . .	3	50.0	10/2/53	1	1.6
Parathion 2% . . . . .	3	50.0	10/2/53	7	0.08
Parathion 2% . . . . .	3	50.0	10/2/53	7	0.04

\* Residue analyses in parts per million—ppm—by Dr. W. M. Hoskins, Department of Entomology and Parasitology, University of California, Berkeley.

#### Results of Chemical Control Experiments During 1953 for Control of the Plume Moth

Treatment (dusts)	Per Cent Wormy Artichokes on Dates Given				Average Worm Damage
	Oct. 9	Oct. 24	Nov. 14	Dec. 7	
Half Moon Bay, San Mateo County <sup>1</sup>					
A—Parathion 2% plus DDT 10% . . . . .	11.0	5.6	1.1	2.1	5.0
B—Parathion 2% . . . . .	8.7	7.5	2.3	3.0	5.4
C—Malathion 4% . . . . .	20.6	15.6	9.0	8.3	13.4
D—Diazinon 2% . . . . .	22.3	16.2	14.3	5.3	14.5
E—Perthane 10% . . . . .	20.4	16.4	13.7	8.2	14.7
F—Nicotine-rotenone <sup>3</sup> . . . . .	18.8	14.6	5.5	5.7	11.2
G—No treatment . . . . .	25.6	18.5	12.0	7.0	15.8
Castroville, Monterey County <sup>2</sup>					
	Oct. 31	Nov. 13	Nov. 27	Dec. 11	
A—Parathion 2% plus DDT 10% . . . . .	11.9	21.6	32.4	37.2	25.8
B—Parathion 2% . . . . .	19.3	25.5	31.2	41.1	29.3
C—Malathion 4% . . . . .	26.0	38.0	49.9	54.8	42.2
D—Perthane 10% . . . . .	20.9	25.7	41.3	44.3	33.1
E—Nicotine-rotenone <sup>3</sup> . . . . .	19.2	35.6	40.0	46.2	35.3
F—No treatment . . . . .	38.8	44.5	48.3	57.1	47.1

<sup>1</sup> Dusted by ground machine on September 4, 16, and October 2, 1953, at 45 pounds to 50 pounds per acre.

<sup>2</sup> Dusted by ground machine September 11 and 25, 1953, at 50-60 pounds per acre.

<sup>3</sup> Active ingredients: rotenone 1.0%; pyrethrins 0.1%; nicotine as alkaloid 4%; Lethane 1.0%; and petroleum oils 1.0%.

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tors should follow all precautions directed by the manufacturer in applying the chemical and should keep out of direct contact with the treated plants for at least 15 days.

### Control Practices

Extensive tests have shown a definite correlation between sanitation and cultural practices and losses due to plume moth. The 1953-54 losses may be—in part, at least—the result of carelessness in carrying through with proper practices.



Discarded artichokes carry over moths.

Adequate sanitation and cultural methods—which should be practiced—will aid in averting severe plume moth damage and can be summarized:

1. All wormy artichokes picked during harvest of the crop should be destroyed and not thrown in the fields near packing houses. This is particularly necessary during March, April and May because hard, dry buds are difficult to destroy and they carry over moths.

2. All thistles of the genus *Cirsium* should be destroyed. The chief offender

in the Castroville area is bull thistle, *Cirsium lanceolatum*.

3. All plant debris should be removed from the fields during the summer as quickly as possible. Burying the plants in a ditch between the rows or burning within two weeks after cutting are the most effective means of destroying eggs, larvae, and pupae. Four times as many adults emerged from an average of six fields where the tops were chopped as emerged from an average of 13 fields where the tops were buried. If the tops are chopped, the debris should be buried in a ditch because the larvae can crawl through several inches of soil.

4. Only clean stock should be planted—eggs, larvae, and pupae can be carried in planting stock to new fields. Plants can be fumigated with methyl bromide at the rate of one pound per 1,000 cubic feet for two hours at 72° F and a vacuum of 20". Or stumps—which carry less larvae—can be planted.

5. Moths often carry over after the plant debris is disposed of during the summer. The new shoots often attract moths from all over as oviposition sites. The tops can be cut off again—1-6 times—to destroy eggs. This will delay the crop but is worthwhile if 10 or more eggs are found per plant.

6. New offshoots should not be planted between old plantings, because the adult moths readily select the new shoots.

7. Community effort to cut—at approximately the same time in adjacent areas—is necessary and will help in averting the movement of adults from cut to uncut fields.

The enactment of a field sanitation program combined with certain cultural practices should be enforced at all times to insure plume moth control. A weak point in the cycle of the moth is the period of cutting of plants from April 15 to June 15, but proper methods must be used.

Insecticides of value for the summer and fall broods are a 2% parathion and a 2% parathion-5% DDT dusts, but they must be properly timed and must be applied prior to bud formation. They cannot be safely used against the spring brood at the present time.

Parathion will also control the artichoke aphid, which is often a serious pest in August and September, and with DDT will control certain caterpillars that occasionally feed on the plants or buds. Adequate ground dusters with at least six nozzles per row must be used.

Under field conditions, natural enemies of the moth have not been too successful on artichoke, due probably to the inaccessibility of the larvae to the



Making a ditch to bury cut plants.

parasites and the presence of hyperparasites. In the use of chemicals, however, every effort should be made to preserve the natural parasite balance. There is no definite indication that applications of chemicals for a limited period of the year adversely affects this balance.

*W. Harry Lange is Associate Professor of Entomology, University of California, Davis.*

*R. H. Sciaroni is Farm Advisor, San Mateo County, University of California.*

*A. S. Greathead is Farm Advisor, Monterey County, University of California.*

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**Left: Ditches completed with plants ready to be thrown in and buried. Right: Cut plants ready for burning.**

