



Female of *Hylemya seneciella* (Meade) on a bud of *Senecio jacobaea* L. The bud is the proper size for oviposition.

TANSY RAGWORT

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The seedfly *Hylemya seneciella* (Meade) joined the cinnabar moth in efforts at biological control of the tansy ragwort, on California rangeland.

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TANSY RAGWORT, *Senecio jacobaea* L., is a stout biennial or short-lived perennial introduced from Europe. At present it infests about 59,000 acres of pasture, range, and wasteland in California. Nearly all of this acreage is in Mendocino and Del Norte Counties. Tansy ragwort is also a serious weed in Oregon, Washington, and southern British Columbia west of the Cascade Range.

Control program

A program to control this noxious weed with insects was started in 1959 when the cinnabar moth, *Tyria jacobaeae* (L.), was introduced from France. Since then, the feeding of its orange and black-striped larvae has had an impact upon the abundance of the weed at Fort Bragg. However, because it is not expected that a single kind of insect will be equally effective over the total range of habitats occupied by its host plant, additional insects were sought in France near Paris to supplement the cinnabar moth.

One of the more obvious and abundant insects on ragwort was the larva of an anthomyiid fly in the seed heads. This fly, *Hylemya seneciella* (Meade), is common in the environs of Paris. Tansy ragwort also is quite abundant, growing in fal-

lowed fields, roadsides, railroad embankments, vacant lots, and in areas disturbed by construction. Therefore, it was not difficult to collect large numbers of specimens.

Host plants

Host plant specificity tests were conducted in Paris in 1963, in Rome in 1964 and 1965, and in Albany, California in 1965. In these tests it was found that *H. seneciella* was unable either to lay eggs in the seed heads, or if a few were laid, the larvae were unable to develop on 39 species of composites including such crop plants as endive, lettuce, safflower, and sunflower and such ornamentals as aster, chrysanthemum, cineraria, dahlia, and marigold.

Another reason for the restricted number of host plants—only two are known in Europe (*Senecio jacobaea* and a very close relative, *S. aquaticus* Huds.)—is that their life history is synchronized with the yearly cycle of the host plants. The fly overwinters as a puparium in the soil. In June the flies emerge from the soil just as tansy ragwort is developing buds. The females are ready to lay eggs when the buds are of the proper size ($\frac{1}{8}$ to $\frac{3}{16}$ inch in diameter) (see photo). Eggs are laid down among the florets or alongside the green bracts of the buds in early July. Only one maggot develops per head even though several eggs may be laid in a head.

The maggots develop throughout July and August and each consumes or damages all of the seeds in the head (photos to right).

Near Paris, the larvae were collected in mid-July when they were approaching full size (up to $\frac{1}{4}$ inch in length) and were easily detected by the damage caused by their feeding within the seed heads. Attacked heads stand out because the florets above where a maggot is feeding first turn brown (in contrast to yellow). Later, as feeding destroys the seeds, the florets are pushed upward and distinctly protrude above the others. As the larva matures, it excretes a frothy material that cements the protruding florets together (as shown in the photo).

Collections

Collections were made by cutting infested plants near the ground and turning them upside down on screens stretched over damp sand. When the maggots completed their feeding, they dropped to the sand, burrowed into it, and pupated. Puparia collected in the summers of 1965, 1966, and 1967 were shipped to Albany in September of each year. There the puparia were held in refrigeration for seven months until the following spring. At greenhouse temperatures, the first flies appeared after 14 to 16 days and fly emergence continued for 19 to 24 days. The flies were fed on yeast hydrolysate and honey until they were taken to the field.

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Maggots of *Hylemya seneciella* in the seed heads of *Senecio jacobaea* L., showing feeding damage, including destruction of the seeds. The maggots feed head downward.

Egg laying

The females require seven to 10 days to develop eggs and 916 females and 137 males nine and 10 days old were released on June 21, 1966 directly onto plants with buds the proper size for oviposition. Many females began to lay eggs promptly upon contacting the buds. Late in July, 100 larvae or attacked heads were found where the flies had been released. However, all of the plants were mowed down shortly thereafter and the infestation died out.

In 1967, a second release at a different location near Fort Bragg was made, using 2,006 younger females. They were one to five days old (53 per cent), six or seven days old (33 per cent), and eight to 10 days old (14 per cent). In early September, 614 damaged heads were found scattered over an area of 0.8 acre. In 1968, 230 infested heads were found on August 14 in a partial survey of the area. In the direction of the prevailing wind, maggots were found 60 yards beyond the 1966 infested area. In 1969 a survey on July 15 revealed 270 infested heads. Because the plants were late in bud development, the flies had scattered out seeking plants with buds of the proper size. For example, 28 per cent of the attacked heads were found up to 100 yards west of the 1968 infested area, against the prevailing winds. Also, infested heads were found 100 yards farther north and 40 yards farther northeast than previously.

In addition to the California releases in 1966 and 1967, a release of 1,408 females and 660 males six to eight days old was made near Corvallis, Oregon on July 21, 1966. Maggots were found in the heads later that year. All of the 1968 flies were shipped to western Washington. A total of 1,721 females and 1,627 males one to four days old was liberated not far from Vancouver between June 20 and July 1. Maggots were found in the heads on August 8 of that same year.

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Three stages in the visible damage to the seed heads caused by larval feeding. On the right is a head that has not been infested. Next to it is an early-stage attack, showing brown florets beyond the protruding one. The third head from the right shows the froth excreted by the maggot. On the left is an example of protruding florets.

