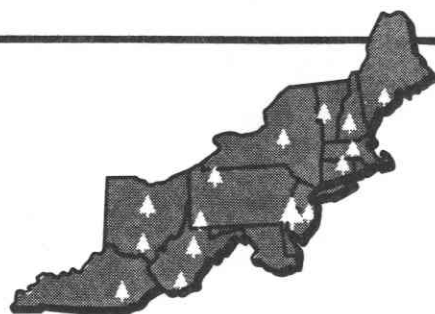


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## SEXING SPRUCE BUDWORM PUPAE

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**Abstract.** Spruce budworm pupae can be sexed by the location and shape of the genital opening. The opening spans the 8th abdominal segment in female pupae and is found on the 9th segment in male pupae.

For biological studies of the eastern spruce budworm, *Choristoneura fumiferana* (Clem.), we need to know how to differentiate the pupal sexes. A method for sexing pupae is required to determine pupal sex ratios, to segregate and rear virgin female moths to be used in sex-attractant studies, and to determine sex of pupae killed by a variety of natural enemies. Both Gibson (1925) and Lambden (1950) illustrated male and female spruce budworm pupae. However, because these papers are generally not available to most field workers, an updated pictorial guide is presented. This Note describes an easy, reliable method for sexing pupae of *C. fumiferana*.

External morphological characters that distinguish pupal sex have been described for a number of lepidopterous pupae. The chief and most reliable character is the location and shape of the genital pore or opening.

In the female pupa, the genital opening is found on the ventral aspect of the 8th abdominal segment (Fig. 1A). The genital opening of the female is longer than that of the male. This opening spans the 8th segment and bisects its caudal margin, extending posteriorly into the cephalic region of the 9th segment. Mesially, the caudal margin of the 8th and the cephalic margin of the 9th segment project cephalad, thus forming an inverted V-shaped marking.

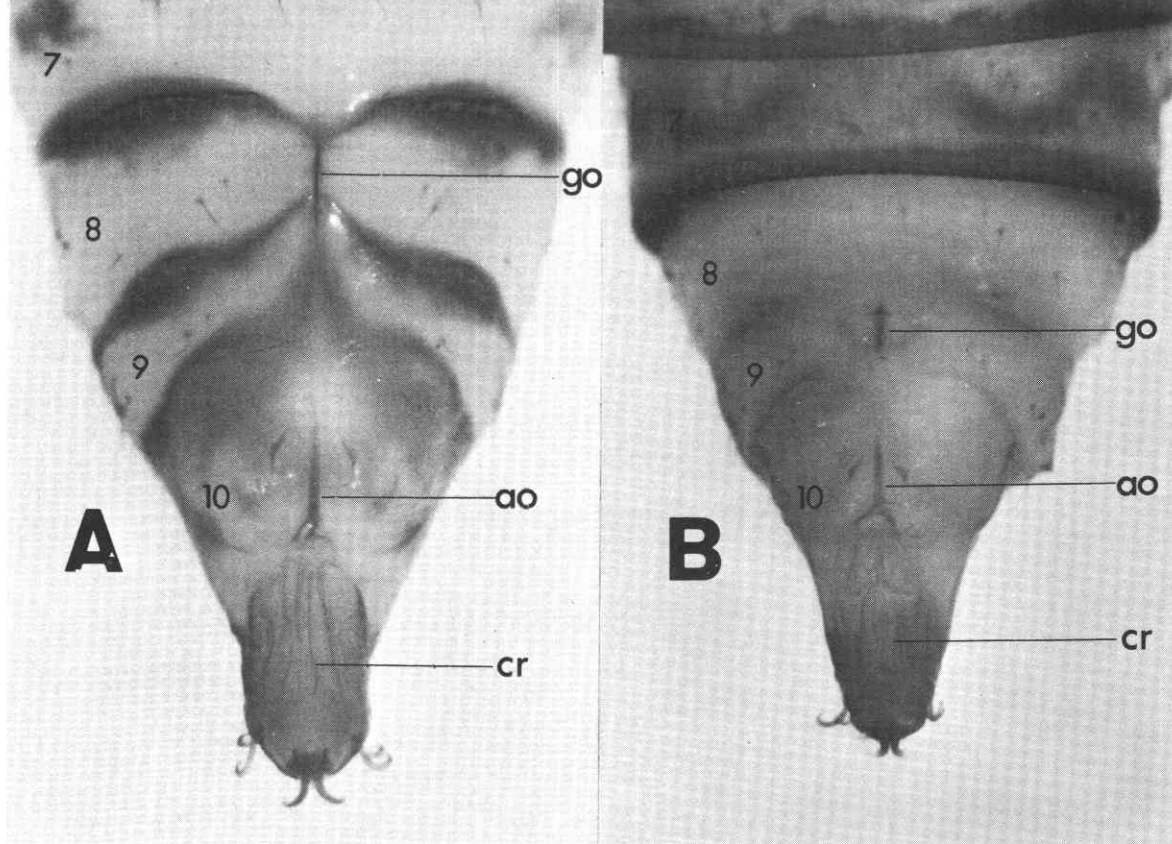
The genital opening of the male pupa is found ventrally on the 9th abdominal segment (Fig. 1B), and is easily recognized by distinctly elevated tubercles, one on each side of the opening.

In both sexes of the spruce budworm, the anal opening is found on the 10th abdominal segment. The cremaster, which is an elongation of the 10th segment, is longer than wide and bears eight strongly hooked setae. Four of the hooked setae are at the apex of the cremaster; two each are located laterally on either side of the cremaster.

Dorsally, the 1st and 10th abdominal segments of spruce budworm pupae are devoid of spines. Two rows of spines, a cephalic row and a caudal row, are found on segments 2 through 8. The cephalic row is generally stouter and more pronounced than the caudal row. Dorsal spines are usually reduced to a single row on segment 9. The thoracic region is considerably enlarged, especially in the region of the wing pads, while the abdomen tapers posteriorly.

Laterally, spiracles are conspicuous on abdominal segments 2 through 7; they are circular and are surrounded by a protruding ring. On segment 8, spiracle vestiges are slitlike and lack a distinct opening.

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**Figure 1.—Ventral view of female (A) and male (B) *Choristoneura fumiferana* pupae, showing genital (go) and anal (ao) openings, cremaster (cr), and abdominal segments 7–10.**

Harvey and Stehr (1967) reported differences in hemolymph pigmentation for several spruce- and pine-feeding *Choristoneura*. They found that only *C. pinus pinus* Freeman was sexually dimorphic in color, with 100 percent of the males yellow and 100 percent of the females green. About 33 percent of the *C. fumiferana* females they examined were yellow, while 67 percent were green; 54 percent of the males were yellow, while 46 percent were green. Thus, coloration is not a good sexing character for *C. fumiferana*.

Because lepidopterous pupae sometimes “curl” or “telescope,” counting the number of abdominal segments visible ventrally and posterior to the wing pads is not a reliable method for sexing pupae. The best criteria for separating pupal sexes of *C. fumiferana* are the relative position and the shape of the genital opening. Intact pupae, and even pupal cases from which adult moths have emerged, can be quickly and accurately sexed using this method. The method is particularly useful for sexing pupal fragments when the 8th or 9th segment is present. As often happens with pupae parasitized by dipterous parasitoids, the host pupa

breaks into fragments when the parasitoid emerges. The posterior portion of the host pupa is usually left intact and remains anchored to the foliage by the cremaster hooks. These fragments can easily be sexed by the method described here.

Spruce budworm pupae can be sexed in the field with a 10× hand lens. Confirmation of sex depends on the position and shape of the genital opening. The anal opening, located on the 10th (last) abdominal segment in both sexes, can be used as a reference point for counting anteriorly.

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