REPELLENCY OF ORAL EXUDATE TO EASTERN AND WESTERN SPRUCE BUDWORM LARVAE (LEPIDOPTERA: TORTRICIDAE)

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Abstract—A two-choice feeding bioassay was used to investigate the intra-specific repellency of the larval oral exudate of eastern and western spruce budworms, Choristoneura fumiferana (Clem.) and C. occidentalis Free., respectively. Results of the bioassay indicated that feeding behavior on artificial diet-drop feeding stations was modified in the presence of exudate, with feeding stations treated with conspecific exudate being avoided when an untreated station was available 3 cm away. Feeding was suppressed when a single, exudate-treated station was provided, or when the treated and untreated stations were separated by only 1 cm. The repellent effect functioned both inter- and intraspecifically. When induced to produce exudate, C. occidentalis larvae were not immediately repelled by either their own or other individuals' exudate. However, 24 hr after induction, test larvae were repelled by exudate from either source. In both species, larval oral exudate probably functions to repel conspecific competitors.

Key Words—Choristoneura fumiferana, Choristoneura occidentalis, spruce budworm, oral exudate, regurgitant.

INTRODUCTION

Many insects release oral secretions when they are disturbed or handled (Davies and McCauley, 1970; Corbet, 1971; Eisner et al., 1974). Such secretions are an important defense against predators and parasites (Eisner et al., 1974). However, they may also play a role in intraspecific interactions, mediating optimal

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larval density in a habitat in a concentration-dependent manner (Corbet, 1971). Recent evidence (Poirier and Borden, 1995) has shown that oral exudate from larvae of eastern and western spruce budworms, Choristoneura fumiferana (Clem.) and Choristoneura occidentalis Free., respectively, may act as an epideictic (spacing) pheromone (Prokopy, 1981). Larvae produced the exudate during intraspecific encounters, and experimental exposure to exudate caused an increase in the proportion of larvae dispersing from established feeding sites (Poirier and Borden, 1995). In the field, generally only one larva is found in each tree bud (L. E. Maclauchlan, British Columbia Ministry of Forests, Kamloops Region, personal communication).

In order for the intraspecific repellency of larval oral exudate to be investigated further, an effective laboratory bioassay procedure was required. Our first objective, therefore, was to develop such a bioassay. Subsequent objectives were to determine the specificity of the exudate between the two Choristoneura species and to determine whether an individual larva could “recognize” whether exudate came from itself or another larva.

METHODS AND MATERIALS

Insects. Second-instar, diapausing larvae of C. fumiferana and C. occidentalis were obtained from the Forest Pest Management Institute, Canadian Forest Service, Sault Ste. Marie, Ontario. These insects were reared in the laboratory at approximately 24°C and 60% relative humidity. Photoperiod was maintained at 16L:8D. Larvae were reared on an agar-based, artificial spruce budworm diet (Bio-Serv Inc., Frenchtown, New Jersey) in 30-ml disposable vials. Two larvae were kept in each vial. Some C. occidentalis larvae were reared on cut branches of Douglas fir, Pseudotsuga menziesii (Mirb.) Franco, collected in Burnaby, British Columbia.

Bioassay Development. To test the repellent effect of larval oral exudate, two drops of molten artificial diet (approximately 0.5 cm in diameter) were placed in the bottom of a 100 × 15-mm disposable Petri dish and allowed to solidify. In all bioassays, the Petri dishes were inverted so that the diet feeding stations were on the “ceiling” of the Petri dish chamber.

In experiments 1 and 2, the two feeding stations were placed in each dish with 3 cm between their centers. In experiments 3 and 4, the two feeding stations were separated by only 1 cm. Each dish for experiments 5 and 6 contained a single feeding station, placed at the center of the chamber. Oral exudate was collected from artificial diet-reared larvae by touching their heads with a 5-μl micropipet (Poirier and Borden, 1995). As much exudate as could be collected from two larvae was used to cover one of the two feeding stations in each dish.