

COMPONENTS OF MALE AGGREGATION PHEROMONE
OF STRAWBERRY BLOSSOM WEEVIL, *Anthonomus rubi*
HERBST. (COLEOPTERA: CURCULIONIDAE)

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(Received July 31, 2000; accepted February 9, 2001)

Abstract—The strawberry blossom weevil, *Anthonomus rubi*, is a major pest of strawberries in the United Kingdom and continental Europe. As part of a project to develop noninsecticidal control methods, the pheromone system of this species was investigated. Comparison of volatiles produced by field-collected, overwintering individuals of each sex led to identification of three male-specific compounds—(*Z*)-2-(3,3-dimethylcyclohexylidene)ethanol, (*cis*)-1-methyl-2-(1-methylethenyl)cyclobutaneethanol, and 2-(1-methylethenyl)-5-methyl-4-hexen-1-ol (lavandulol)—in amounts of 6.1, 1.2, and 0.82 $\mu\text{g/day}$ /male. The first two compounds are components of the aggregation pheromone of the boll weevil, *Anthonomus grandis*, grandlure II and grandlure I, respectively. Grandlure I was the (1*R*,2*S*)-(+)-enantiomer and lavandulol was a single enantiomer, although the absolute configuration was not determined. Trace amounts of the other two grandlure components (*Z*)-(3,3-dimethylcyclohexylidene)acetaldehyde (grandlure III) and (*E*)-(3,3-dimethylcyclohexylidene)acetaldehyde (grandlure IV) were also detected. (*E,E*)-1-(1-Methylethyl)-4-methylene-8-methyl-2,7-cyclo-decadiene (germacrene-D), a known volatile from strawberry plants, *Fragaria ananassa*, was collected in increased amounts in the presence of pheromone-producing weevils. Male weevils only produced pheromone on *F. ananassa* and not on scented mayweed, *Matricaria recutita*, or cow parsley, *Anthriscus sylvestris*, although these are known food sources. In field trials using various combinations of synthetic grandlures I, II, III, and IV and lavandulol, significantly more weevils were caught in traps baited with blends containing grandlure I and II and lavandulol than in those baited with blends without lavandulol or unbaited controls. Addition of grandlure III and IV had no

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significant effect on attractiveness. Horizontal sticky traps were found to be more effective than vertical sticky traps or standard boll weevil traps. In mid-season females predominated in the catches, but later more males than females were trapped.

Key Words—Strawberry blossom weevil, *Anthonomus rubi*, Curculionidae, Coleoptera, aggregation pheromone, Grandlure, lavandulol, germacrene-D.

INTRODUCTION

The strawberry blossom weevil, *Anthonomus rubi* Herbst (Coleoptera: Curculionidae), is a major pest of strawberry crops in the United Kingdom and Europe (Cross and Easterbrook, 1998; Hoffman, 1954; Popov, 1996) and is sometimes a pest of raspberry (Alford, 1984). The weevil is univoltine, and adults emerge in late April from overwintering sites of leaf litter and soil adjacent to strawberry fields (Fenouhlet, 1907; Jary, 1932). It feeds initially on strawberry foliage before mating commences at the onset of flower bud formation. Diapausal adults emerge six to eight weeks after oviposition. It feeds in and around the strawberry crop for about two weeks until leaving the crop for an overwintering site in late July/early August (Jary, 1932; Morris, 1977). Strawberry crop loss is a result of the oviposition behavior of the female, which involves deposition of a single egg in an unopened strawberry bud, followed by severing of the stalk below the bud (Jary, 1932; Alford, 1984). A single female lays up to 50 eggs and potential crop losses are great even at low population levels. Owing to the small size of the weevil and the nature of the damage, effects on the crop are often unnoticed until it is too late to take remedial action. Current control involves the routine use of broad-spectrum insecticides, e.g., chlorpyrifos, which is unsatisfactory due to high cost, environmental affects, and negative public perception. Thus, a more cost-effective, benign, and acceptable control method is desirable.

Extensive work has been carried out on identification of pheromones and their use within the Curculionidae (Bartelt, 1999), exemplified by the decades of research conducted on the boll weevil, *Anthonomus grandis* (Coleoptera: Curculionidae) (Hardee and Mitchell, 1997). Following identification of four components of the male aggregation pheromone of *A. grandis*, given the trivial name grandlure, (Tumlinson et al., 1969), pheromones of several weevil species have been identified. These include two from within the same subfamily as *A. grandis*, the pepper weevil *A. eugenii* (Eller et al., 1994) and the pecan weevil *Curculio caryae* (Hedin et al., 1996, 1997), both of which produce male aggregation pheromones incorporating Grandlure components.

Although there have been no reports of pheromonal attraction for *A. rubi*, the successful identifications from within the same genus encouraged a preliminary trapping study with this species, the results of which led to the investigation of the composition of the pheromone.