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Abstract—Electrophysiological recordings from antennal olfactory receptors and field behavioral experiments showed both male and female boll weevils, *Anthonomus grandis* Boh. (Coleoptera: Curculionidae), to respond specifically to (+)-grandisol, an enantiomer of compound I of the boll weevil aggregation pheromone. Single-cell recordings revealed antennal olfactory neurons in both male and female weevils keyed to (+)-grandisol. Electroantennograms in response to serial dilutions of the grandisol enantiomers showed a threshold 100 to 1000 times lower for (+)-grandisol relative to its antipode. In field behavioral experiments, both sexes were significantly more attracted to (+)-grandisol in combination with the three other pheromone components than the combination with (−)-grandisol. When (−)-grandisol was placed with the (+)-enantiomer at equal dosages, a slight although statistically insignificant inhibition occurred. Subsequent field tests showed that the low level of attraction exhibited by (−)-grandisol in combination with the other three pheromone components could be attributed to the other three components alone. These results are in contrast with an earlier study, which found (−)-grandisol to be as attractive as the (+)-enantiomer.

Key Words—Boll weevil, olfaction, receptor cell, *Anthonomus grandis*, Coleoptera, Curculionidae, enantiomer, grandisol, chirality, electroantennogram, aggregation pheromone, neurobiology, structure–activity.
INTRODUCTION

The importance of chirality in insect chemical communication is well known (Silverstein, 1979; Mori, 1984). Sensitivity and specificity in the detection and translation of pheromonal messengers by insects are especially crucial since chiral chemical cues may be important in their orientation to conspecifics for aggregation and/or mating. In general, insects that produce a chiral pheromone detect and respond behaviorally to the predominant enantiomer or blend of enantiomers released (Iwaki et al., 1974; Borden et al. 1976, 1980; Hedden et al., 1976; Klimetzek et al., 1976; Vité et al., 1976a,b; Wood et al., 1976; Yamada et al., 1976; Birch et al., 1977, 1980; Harring and Mori, 1977; Kráweitza et al., 1977; Miller et al., 1977; Lanier et al., 1980; Levinson and Mori, 1980; Mustaparta et al., 1980; Payne et al., 1982; Dickens et al., 1985; Kodama et al., 1987). However, the antipode of the insect's pheromone may be released by a sympatric species or a different population of the same species and may inhibit response to the pheromone (Vité et al., 1976b; Light and Birch, 1979).

Male boll weevils, *Anthonomus grandis* Boh. (Coleoptera: Curculionidae), release in their frass an aggregation pheromone that consists of four components: I, (+)-cis-2-isopropenyl-1-methylcyclobutane ethanol; II, cis-3,3-dimethyl-\(\Delta^{1,8}\)-cyclohexane ethanol; III, cis-3,3-dimethyl-\(\Delta^{1,0}\)-cyclohexane acetaldehyde; and IV, trans-3,3-dimethyl-\(\Delta^{1,0}\)-cyclohexane acetaldehyde (Tumlinson et al., 1969). Although one of these pheromone components, I (grandisol), is produced as the (+)-enantiomer by the insect, its antipode, (−)-grandisol, was shown to have biological activity equal to the isolated pheromone component (Mori et al., 1978).

The biological activity of (−)-grandisol (Mori et al., 1978) has been an anomaly in insect pheromone biology. This remains as one of only two reports in which an insect produced one enantiomer of a compound as its pheromone, and its antipode, once synthesized, had equal biological activity (Mori et al., 1978, 1981). Although Silverstein (1979) reported that no instances had been documented in which an insect produced only a single enantiomer and could not distinguish between it and its antipode, he did cite earlier work in which humans were sometimes unable to distinguish between enantiomers (Lensky and Blum, 1974).

The purpose of the experiments reported here was to investigate detection of the enantiomers of grandisol by the boll weevil through electrophysiological recordings from the antennal receptors. In addition, due to results of the electrophysiological experiments, which indicated a lack of detection of (−)-grandisol, quantitative behavioral experiments were done in the field to reinvestigate previously reported biological activity of the antipode of the pheromone component (Mori et al., 1978).