

**(Z)-3- and (Z)-5-Decenyl Acetates,  
Sex-Attractant Components for Male  
*Eustrotia uncula* Cl. (Lepidoptera: Noctuidae)**

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Male *E. uncula* showed a synergistic response to lures containing Z3-10:Ac and Z5-10:Ac in a Z3/Z5 ratio of 1/10. The dodecenyl compounds Z5-12:Ac, Z7-12:Ac and Z7-12:OH, perceived *via* further types of antennal receptor cells, acted inhibitorily on this binary lure. Two species of *Euxoa* also responded to Z3-10:Ac as a single compound or lure component, respectively. This is the first report of a  $\Delta$ 3-alkenyl compound being involved in sexual attraction in the Noctuidae.

Straight-chain alkenols and their acetate and aldehyde analogues are the prevailing type of sex pheromone structure known from Lepidoptera [1]. In the family Noctuidae, identified alkenyl compounds range from 10 to 16 carbons in chain length and have their olefinic double bond at either the 5, 7, 9 or 11 position [1–3]. This report provides evidence for a  $\Delta$ 3 homologue, (Z)-3-decenyl acetate (Z3-10:Ac), being involved in sex-attractant systems in this moth family.

The compound is a reported component of a synthetic lure used for monitoring populations of European goat moth, *Cossus cossus* L. (Cossidae) [4, 5] and is probably part of the pheromone of this species [5]. The single chemical has, on the other hand, been shown to attract a male casebearer, *Coleophora versurella* Zell. (Coleophoridae) [6]. Our own unpublished results point to pheromonal functions of the Z3-10:Ac for various further spp. of this latter and same related (gelechioid) families; e.g., the single compound also attracts male *Depressaria olerella* Zell. and further *Coleophora* spp. such as *C. auricella* (F.), *C. serpylletorum* E. Her. and *C. sternipennella* (Zett.), whereas the combination with its (Z)-5 positional isomer, Z3-10:Ac / Z5-10:Ac in ratio 1/1, is a potent lure for male *Agonopteryx yeatiana* F. or *Coleophora viminetella* Zell. [7]. During field work on these gelechioid moths, the specific attraction of certain male Noctuidae to lures containing Z3-10:Ac was noted.

A decade of extensive field trapping, conducted in various habitats near Seewiesen, southern Germany, failed to reveal significant noctuid captures by Z3-10:Ac alone. However, whilst evaluating mixtures of Z3-10:Ac / Z5-10:Ac for attractivity to certain male Coleophoridae and Oecophoridae, substantial numbers of a Noctuidae: Acontiinae species, *Eustrotia uncula* Cl., were caught. The males responded to mixtures of the two compounds in a Z3/Z5 ratio of 3/100 or 10/100 but not to mixture ratios such as 100/100 or 100/10, or the single chemicals alone.

*E. uncula* feeds on sedges (*Carex* and *Cyperus* spp.) and is locally common in marshes and moorlands of central and northern Europe. There are no reports in the literature concerning its sex pheromone or male responses to synthetic attractants. The unique response to lures containing a  $\Delta$ 3-alkenyl compound, discovered accidentally, prompted a closer examination of its sex-attractant system.

Single unit recordings were made from *E. uncula* male antennae to define the different cells types participating in the olfactory receptor system of the sensilla trichodea. Technical procedures and sets of test chemicals were as used for other noctuid species [8–10]. Four types of acetate-sensitive cells and one type sensitive to alcohols were found and, on the basis of response spectra to test chemicals, shown to be specialist receptors for Z3-10:Ac, Z5-10:Ac, Z5-12:Ac, Z7-12:Ac and Z7-12:OH. There was no evidence for the presence of further cell types in these recordings.

With these five “receptor key compounds” identified, *E. uncula* trapping experiments continued in moorlands near Seewiesen, using procedures as in field work on other noctuid species [8, 9]. The limitation of male attraction to a particular range of Z3-10:Ac / Z5-10:Ac mixtures was confirmed by a further test series, again showing maximum captures for the 10/100 ratio (Table I).

The three other “key compounds”, Z5-12:Ac, Z7-12:Ac and Z7-12:OH, have already been included in previous tests (not specified here) conducted, with respect to certain other moth species, at these sites during the time of *E. uncula* flight. No male of the species was ever caught in these tests, suggesting that these three chemicals had no attractivity on their own. Their effects were therefore studied as third components added to the attractive mixture of 10  $\mu$ g Z3-10:Ac + 100  $\mu$ g Z5-10:Ac. A

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Table I. Trap captures of male *Eustrotia uncula* with different mixture ratios of (Z)-3- and (Z)-5-decenyl acetates. Seewiesen, July 12 to August 27, 1986; three replicates.

Amount [ $\mu\text{g}/\text{trap}$ ] of		No. <i>E. uncula</i> caught
Z3-10:Ac	Z5-10:Ac	
100	—	0
100	10	0
100	30	1
100	100	0
30	100	9
10	100	26
3	100	19
1	100	5
—	100	0

10  $\mu\text{g}$  of either Z7-12:Ac or Z7-12:OH, or 100  $\mu\text{g}$  of Z5-12:Ac, strongly reduced captures (Table II). Further testing using lower (0.3  $\mu\text{g}$ –3  $\mu\text{g}$ ) additions of these compounds, conducted in 1988 (data not specified), failed to establish synergistic effects for lower doses of these compounds, which thus should be classified as inhibitors of the *E. uncula* sex-attraction response. Several further compounds (acetates, alcohols, aldehydes), also tested this way, did not markedly modify captures.

During these *E. uncula* tests, no other male noctuids were specifically captured by combinations of Z3-10:Ac / Z5-10:Ac, but in field trials in the southern Alps a Noctuidae: Agrotinae species, *Euxoa eruta* Hbn., responded to the 1/1 mixture of the two chemicals. Other mixture ratios were not included at the same sites, so the optimum ratio for attracting *E. eruta* males remained undetermined. Furthermore, pure Z3-10:Ac, unattractive to male noctuids in the Seewiesen area as mentioned above, at these

Table II. Trap captures of male *Eustrotia uncula* with 10  $\mu\text{g}$  (Z)-3-decenyl acetate + 100  $\mu\text{g}$  (Z)-5-decenyl acetate as the basic lure and (Z)-5-dodecenyl acetate, (Z)-7-dodecenyl acetate or (Z)-7-dodecen-1-ol as a third component. Seewiesen, July 18 to September 5, 1987; four replicates.

Third compound, $\mu\text{g}$	No. <i>E. uncula</i> caught
none	21
Z5-12:Ac, 10	34
100	5
Z7-12:Ac, 10	7
100	0
Z7-12:OH, 10	2
100	0

more southern localities attracted large numbers of male *Euxoa distinguenda* Led.

The data presented point to a potential sex-attractant function of the Z3-10:Ac in different groups of Noctuidae, though evidently restricted to just a few species. Biosynthetically, based on pathways established for other noctuid species [11–13], the compound can be considered as a further offshoot of a route by which (Z)-7-tetradecenyl and (Z)-5-dodecenyl compounds have been shown to arise from (Z)-11-octadecenoate *via* chain shortening. Both Z7-14:Ac and Z5-12:Ac are known sex-attractant components in the two noctuid subfamilies mentioned here [1–3].

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