

A FACILE ROUTE TO THREE OF THE FOUR TERPENOID
COMPONENTS OF THE BOLL WEEVIL SEX ATTRACTANT

James H. Babler and Thomas R. Mortell

Department of Chemistry, Loyola University of Chicago

Chicago, Illinois 60626 USA

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Recently J. H. Tumlinson, R. C. Gueldner, D. D. Hardee, A. C. Thompson, P. A. Hedin, and J. P. Minyard reported¹ identification and synthesis of the four compounds (1, 2, 3, and 4) comprising the boll weevil sex attractant. These compounds are currently of considerable interest since they may provide a relatively nontoxic method of surveying and controlling the boll weevil population. This letter describes a facile route to the aldehyde components (1 and 2) in 60% overall yield. Separation of this mixture, followed by reduction of Z-aldehyde 1 with sodium borohydride, offers a route to the third component, Z-alcohol 3.

Birch reduction² of m-methylanisole (5) followed by hydrolysis and conjugate addition of lithium dimethylcopper afforded ketone 6 [bp 58-62° (15 mm); $\lambda_{\text{max}}^{\text{film}}$ 5.79 μm (C=O); $\delta_{\text{TMS}}^{\text{CCl}_4}$ 0.98 (s, 6H, geminal CH₃) and 2.08 (s, 2H, -COCH₂C(CH₃)₂-)], the same intermediate utilized in the previous synthesis.¹ A study was subsequently undertaken to determine the stereoselectivity of a modified Wittig reaction³ between ketone 6 and the commercially available⁴ diethyl cyanomethylphosphonate (7). The sole product isolated from this reaction in 95-100% yield was an inseparable mixture of α,β -unsaturated nitriles⁵ 8 and 9 [$\lambda_{\text{max}}^{\text{film}}$ 4.51 (C=N) and 6.11 μm (C=C); Z isomer (8): $\delta_{\text{TMS}}^{\text{CCl}_4}$ 0.99 (s, 6H, geminal CH₃) and 5.12 (m, C=CH); E isomer (9): $\delta_{\text{TMS}}^{\text{CCl}_4}$ 0.93 (s, 6H, geminal CH₃) and 5.01 (m, 1H, C=CH)].

An effort was made to maximize the yield of unsaturated nitrile 8, the necessary precursor for Z-alcohol 3, but as the results given in Table I indicate, the reaction showed little stereoselectivity.³ Nonetheless, nitriles 8 and 9 could be reduced in 80-90% yield to a mixture of the corresponding aldehydes⁶ 1⁷ [$\delta_{\text{TMS}}^{\text{CCl}_4}$ 0.99 (s, 6H, geminal CH₃), 5.87 (broad d, J = 7.8, 1H, C=CH), and 9.98 (d, J = 7.8, 1H, CHO)] and 2 [$\delta_{\text{TMS}}^{\text{CCl}_4}$ 0.95 (s, 6H, geminal CH₃), 5.73 (broad d, J = 7.8, 1H, C=CH), and 10.02 (d, J = 7.8, 1H, CHO)] by use of one equivalent of diisobutyl aluminum hydride.⁸

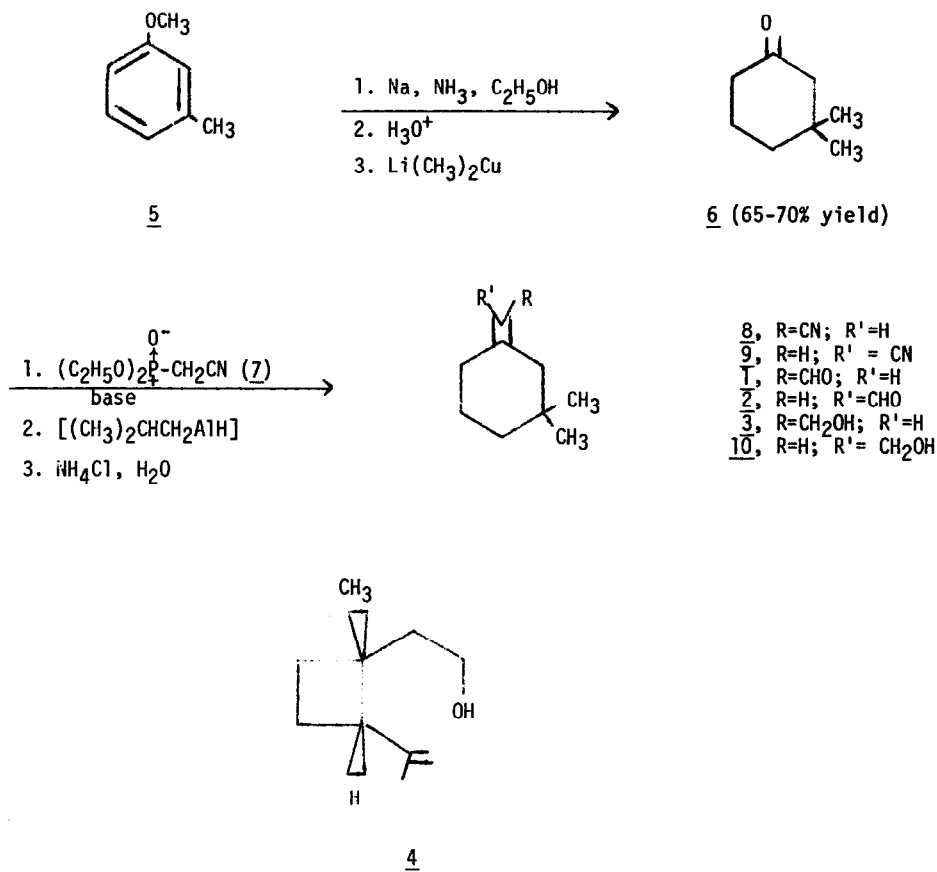


TABLE I
Preparation of α,β -Unsaturated Nitriles 8 and 9

% Z-isomer (<u>8</u>) ⁹	% E-isomer (<u>9</u>) ⁹	Base	Solvent ¹⁰
28	72	CH ₃ Li	C ₆ H ₆
50	50	NaH	9:1 C ₆ H ₆ -pentane
45	55	NaOC ₂ H ₅	CH ₃ CH ₂ OH
50	50	NaOC(CH ₃) ₃	(CH ₃) ₃ COH
60	40	NaH	DMF or DMSO
28	72	(CH ₃ CH ₂ CH ₂ CH ₂) ₄ ⁺ NOH ⁻	1:1 C ₆ H ₆ -CH ₃ OH

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2. A. J. Birch, Quart. Rev. (London), **4**, 69 (1950).
A. J. Birch and H. Smith, ibid., **12**, 17 (1958).
3. For a discussion of the factors that determine the stereoselectivity in modified Wittig reactions between ketones and stable ylids, refer to: "The Stereochemistry of the Wittig Reaction," by Manfred Schlosser, in Topics in Stereochemistry, edited by E. L. Eliel and N. L. Allinger, Wiley-Interscience (New York: 1970), pp. 1-30.

4. Aldrich Chemical Company, Inc., Milwaukee, Wis. 53233 USA.
5. Analysis of a 50:50 mixture of nitriles 8 and 9: Calcd for $C_{10}H_{15}N$: C, 80.5; H, 10.1; N, 9.40. Found: C, 80.4; H, 10.1; N, 9.35.
6. The authors wish to thank Dr. R. C. Gueldner of the Boll Weevil Research Laboratory of the U. S. Department of Agriculture for comparing our spectra with those obtained previously by him and his coworkers. The minor discrepancies between the two sets of NMR data is undoubtedly due to a concentration effect.
7. Reduction of a mixture of aldehydes 1 and 2 with sodium borohydride (in ethanol, 25°, 1 hr) afforded the corresponding mixture of Z-alcohol (3) and its E-isomer (10) in quantitative yield. Since Z-alcohol must be free of E-alcohol or the attractiveness of the sex attractant mixture is reduced, either aldehydes 1 and 2 could be separated prior to this step, or alcohols 3 and 10 would have to be purified after the reduction. For a description of the procedure used to separate aldehydes 1 and 2, refer to: "The Boll Weevil Sex Attractant", by J. H. Tumlinson, R. C. Gueldner, D. D. Hardee, A. C. Thompson, P. A. Hedin, and J. P. Minyard, in Chemicals Controlling Insect Behavior, edited by M. Beroza, Academic Press (New York: 1970) p. 50.
8. A. E. G. Miller, J. W. Biss, and L. H. Schwartzman, J. Org. Chem., 24, 627 (1959). S. Trofimenko, J. Org. Chem., 29, 3046 (1964).
9. The ratio of 8:9 was determined via integration of the vinyl hydrogen NMR absorption band for each isomer.
10. All reactions were run at room temperature over a period of 0.5 to 2.0 hrs.