SUPPORTING INFORMATION

Title: Construction of Highly Substituted Stereodefined Dienes by Cross-Coupling of α-Allenic Acetates

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General. Unless otherwise indicated, reactions were carried out under a nitrogen atmosphere in flame- or oven-dried glassware using freshly distilled solvents. THF was distilled from sodium/benzophenone. Dichloromethane was distilled from calcium hydride. Triethylamine was distilled from calcium hydride, and stored over potassium hydroxide. Reactions were monitored by thin layer chromatography (TLC) with 0.25 mm E. Merck pre-coated silica gel plates. Silica gel for flash chromatography (particle size 32-63 µm) was supplied by Silicycle. Yields refer to chromatographically and spectroscopically pure compounds unless otherwise noted. $^1$H and $^{13}$C spectra were recorded on Bruker Avance DPX-500 or Bruker Avance DPX-400 spectrometers. Chemical shifts are reported as $\delta$ values in ppm using an internal chloroform standard ($\delta$ 7.27 for $^1$H and $\delta$ 77.0 for $^{13}$C) or benzene standard ($\delta$ 7.16 for $^1$H and $\delta$ 128.4 for $^{13}$C). J values are reported in Hz. Infrared spectra were recorded on a Midac M-1200 FTIR. Optical rotations were measured on a Perkin-Elmer model 341 polarimeter. High resolution mass spectra were measured at the University of Illinois Mass Spectrometry Center. Low resolution mass spectra were acquired on a Waters Micromass ZQ mass Spectrometer by chemical ionization (CI) or electrospray ionization (ESI).

General Procedures for Preparation of Substrates:

Addition of Ethynylmagnesium bromide to Ketones:

Methyl ketone (12 mmol) was dissolved in 25mL of freshly distilled THF. The solution was cooled to 0°C, and 48mL ethynylmagnesium bromide (0.5M solution in THF) was added dropwise, and the solution was warmed to room temperature over night. The reaction was quenched with saturated aqueous ammonium chloride, diluted with ethyl acetate, and stirred until the layers were clear (1-2 h). The aqueous layer was separated and extracted with ethyl acetate. The combined organic layers were washed with water (3 x 150 mL) and brine (150 mL), dried over sodium sulfate, and concentrated in vacuo. The resultant oil was purified by flash chromatography to afford ethynyl carbinol in ~85-97% yield.
**Crabbé Homologation of Ethynyl Carbinols To Allenols:**

Ethynyl carbinol (11.9 mmol) was dissolved in 120 mL anhydrous 1,4-dioxane. To the solution was added copper(I) bromide (854mg, 5.96 mmol), paraformaldehyde (1.793g, 59.6 mmol), and diisopropylamine (1.6mL, 0.14mL/mmol). The resultant orange solution was refluxed for 16h. The volatile components were removed by concentration *in vacuo*, and the residue was partitioned between water and ethyl acetate. The aqueous layer was extracted with ethyl acetate, and the combined organic layers were washed with water (2 x 150 mL) and brine (1 x 150 mL), dried over sodium sulfate, and concentrated *in vacuo*. The residue was purified by flash chromatography to afford pure $\alpha$-allenic alcohol in 60-85% yield.

**Acetylation of $\alpha$-allenic Alcohols:**

$\alpha$-allenic alcohol (6.49 mmol) was dissolved in pyridine (13mL). To this solution was added acetic anhydride (0.58mmol, 0.09mL/mmol) and 4-dimethylaminopyridine (79mg, 0.65 mmol). The solution was heated to 45°C and stirred overnight. If at this time the reaction was judged to be incomplete by TLC, an extra portion of acetic anhydride (0.58mmol, 0.09mL/mmol) was added and the reaction was stirred at 45°C until complete. The reaction was diluted with ethyl acetate, and washed with water (1 x 100mL), copper sulfate (3 x 100mL), water (1 x 100mL), and brine (1 x 100mL). The organic layer was dried over sodium sulfate and concentrated under reduced pressure, after which it was purified by flash chromatography to afford the $\alpha$-allenic acetate in 75-90% yield.

**Spectroscopic Data for Substrates and Products:**

Entry 1 ($2a$): Recovered 54mg, 85%.
1H NMR \[ \delta (500 \text{ MHz}; \text{C}_6\text{D}_6), 7.15 (m, 2H), 7.06 (m, 3H), 5.69 (s, 1H), 5.02 (q, 1H, \text{J} = 1.5), 4.88 (s, 1H), 2.69 (t, 2H, \text{J} = 7.1), 2.38 (t, 2H, \text{J} = 7.1), 1.85 (m, 1H), 1.72 (d, 3H, \text{J} = 1.5), 1.65-1.75 (m, 4H), 1.61 (m, 1H), 1.0-1.14 (m, 5H). \]

13C NMR \[ \delta (125 \text{ MHz}; \text{C}_6\text{D}_6) 148.0, 142.8, 142.5, 129.0, 128.8, 126.4, 126.2, 113.9, 40.3, 38.7, 35.6, 20.2, 18.6, 14.7, 12.6. \]

LRMS \( m/z \) (CI) 254.4 (M+).

IR (film) \( \nu_{\text{max}} = 2944, 2893, 2867, 1724, 1464, 1369, 1260, 1112, 1015, 998, 936, 883, 698, 681. \)

Entry 2: Recovered 51mg, 81%

1H NMR \[ \delta (500 \text{ MHz}; \text{C}_6\text{D}_6) 7.47 (m, 2H), 7.22 (m, 3H), 6.07 (s, 1H), 5.46 (d, 1H, \text{J} = 2.0), 5.27 (d, 1H, \text{J} = 2.1), 5.31 (s, 1H), 5.24 (s, 1H), 1.89 (m, 1H), 1.79 (d, 3H, \text{J} = 2.0), 1.7-1.75 (m, 4H), 1.66 (m, 1H), 1.1-1.13 (m, 5H). \]

13C NMR \[ \delta (125 \text{ MHz}; \text{C}_6\text{D}_6) 152.3, 148.4, 144.8, 141.6, 136.2, 128.7, 128.3, 123.3, 118.2, 115.1, 47.9, 32.1, 26.9, 26.6, 16.2. \]

LRMS \( m/z \) (CI) 252.1 (M+).

HRMS (EI) \( m/z \) 252.1881 [calc’d for C_{19}H_{24} (M+) 252.1878].

IR (film) \( \nu_{\text{max}} = 2925, 2851, 1583, 1492, 1444, 1027, 899, 776, 701. \)
Entry 3:  

**1H NMR**  
$\delta_{H} (500 \text{ MHz; CDCl}_3) 5.81 (s, 1H), 5.11 (s, 1H), 4.99 (s, 1H), 1.89 (s, 3H), 1.85 (s, 3H), 1.72-1.8 (m, 4H), 1.65-1.7 (m, 2H), 1.1-1.3 (m, 5H).

**13C NMR**  
$\delta_{c} (125 \text{ MHz; CDCl}_3) 142.7, 142.5, 125.6, 114.1, 48.5, 32.1, 27.0, 26.6, 24.2, 16.2$.

**LRMS**  
$m/z (\text{CI}) 164.5 (M^+)$.

**HRMS**  
$(\text{EI}) m/z 164.1657$ [calc’d for C$_{12}$H$_{20}$ (M$^+$) 164.1565].

**IR**  
$(\text{film}) \nu_{\text{max}} = 2926, 2853, 1691, 1450, 1373, 1060, 891$.

Entry 4:  

**1H NMR**  
$\delta_{H} (500 \text{ MHz; CDCl}_3) 5.77, (s, 1H), 5.14 (s, 1H), 4.97 (s, 1H), 2.17 (q, 2H, $J = 1.2$), 1.92 (m, 1H), 1.84 (s, 3H), 1.65-1.8 (m, 4H), 1.2-1.3 (m, 5H) 1.30 (t, 3H, $J = 1.2$).

**13C NMR**  
$\delta_{c} (125 \text{ MHz; CDCl}_3) 148.2, 143.4, 124.6, 111.6, 48.3, 32.2, 31.1, 27.0, 26.6, 16.3, 13.1$.

**LRMS**  
$m/z (\text{EI}) 178.3 (M^+)$.

**HRMS**  
$(\text{EI}) m/z 178.1722$ [calc’d for C$_{13}$H$_{22}$ (M$^+$) 178.1722].

**IR**  
$(\text{film}) \nu_{\text{max}} = 2963, 2926, 2852, 1449, 1373, 1072, 891$. 

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[Diagram of molecule]
Entry 5: Recovered 29mg, 47%

$^1$H NMR $\delta_H (500 \text{ MHz}; \text{C}_6\text{D}_6) 5.90 (s, 1H), 5.72 (s, 1H), 5.33 (s, 1H), 2.03 (s, 3H), 1.5-1.8 (m, 5H), 1.0-1.3 (m, 6H), 0.19 (s, 9H).

$^{13}$C NMR $\delta_C (125 \text{ MHz}; \text{C}_6\text{D}_6) 146.3, 129.4, 125.6, 122.3, 107.0, 95.1, 49.0, 32.0, 27.1, 26.7, 16.0, 0.2.$

HRMS (EI) $m/z$ 401.3221 [calc’d for C$_{26}$H$_{44}$OSi (M$^+$) 401.3240].

IR (film) $\nu_{\text{max}} = 2930, 2853, 1738, 1451, 1249, 842, 758.$

Entry 6: Recovered 56mg, 92%

$^1$H NMR $\delta_H (500 \text{ MHz}; \text{CDCl}_3) 7.30 (\text{dd}, 2H, J = 4.8, 8.4), 6.89 (\text{t}, 2H, J = 8.4), 6.01 (s, 1H), 5.48 (d, 1H, J = 1.7), 5.13 (s, 1H), 1.95 (m, 1H), 1.74 (m, 4H) 1.70 (d, 3H, J = 1.7), 1.64 (m,1H), 1.1-1.3 (m, 5H).

$^{13}$C NMR $\delta_C (125 \text{ MHz}; \text{CDCl}_3) 163.8, 144.8, 128.5, 128.4, 123.3, 115.3, 115.1, 114.2, 47.9, 32.2, 27.9, 18.5.$

LRMS $m/z$ (CI) 244.3 (M$^+$).

HRMS (EI) $m/z$ 244.1627 [calc’d for C$_{17}$H$_{21}$F (M$^+$) 244.1627].

IR (film) $\nu_{\text{max}} = 2987, 2030, 2854, 1741, 1451, 1366, 1246, 1188, 1095, 1048, 1015, 843, 756.$
Entry 7: Recovered 103mg, 87%

\[ ^1H \text{NMR} \quad \delta_1 \text{(500 MHz; C}_6\text{D}_6) \quad 7.25 \text{ (m, 2H), 7.15 (m, 3H), 5.84 (s, 1H), 5.08 (s, 1H), 4.96 (s, 1H), 3.74 \text{ (t, } 2H, J = 5.9), 2.78 \text{ (t, } 2H, J = 8.0), 2.45 \text{ (t, } 2H, J = 8.0), 1.77 \text{ (s, 3H), 1.64 (m, 1H), 1.15-1.25 (m, 21H), 1.10 (d, 3H, J = 7.0).} \]

\[ ^{13}C \text{NMR} \quad \delta_c \text{(125 MHz; C}_6\text{D}_6) \quad 145.7, 142.8, 142.5, 128.9, 128.6, 126.0, 125.9, 113.8, 62.6, 40.4, 40.3, 38.7, 35.6, 20.2, 18.5, 14.7, 12.6. \]

\[ \text{LRMS} \quad m/z \text{(CI) 401.1 (M)}. \]

\[ \text{HRMS} \quad \text{(EI) } m/z 401.3221 \text{ [calc’d for C}_{26}\text{H}_{44}\text{OSi (M) 401.3240].} \]

\[ \text{IR} \quad \nu_{\text{max}} = 3028, 2942, 2866, 1497, 1382, 1258, 1104, 1013, 883, 744. \]

\[ [\alpha]_D^{20} \text{ } +0.014^\circ \text{ (c = 0.2, CHCl}_3). \]

Entry 8: Recovered 52mg, 91%

\[ ^1H \text{NMR} \quad \delta_1 \text{(500 MHz; C}_6\text{D}_6) \quad 7.28 \text{ (m, 2H), 7.20 (m, 3H), 5.77 (s, 1H), 5.13 (s, 1H), 5.00 (s, 1H), 2.82 (t, 2H, J = 7.4), 2.49 (t, 2H, J = 7.4), 2.00 (d, 1H, J = 6.7), 1.83 (s, 3H), 0.99 (d, 6H, J = 6.7).} \]

\[ ^{13}C \text{NMR} \quad \delta_c \text{(125 MHz; C}_6\text{D}_6) \quad 145.8, 142.3, 137.9, 128.8, 128.5, 127.6, 126.1, 113.5, 50.5, 40.2, 35.3, 26.5, 22.6, 18.0. \]
**LRMS**  
$m/z$ (EI) 228.2 ($M^+)$.

**HRMS**  
(EI) $m/z$ 228.1884 [calc'd for C$\textsubscript{17}$H$\textsubscript{24}$ ($M^+$) 228.1878].

**IR**  
(film) $\nu_{\text{max}} = 3027, 2953, 2867, 1629, 1463, 1383, 893, 747$.

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**Entry 9:**  
Recovered 54 mg, 87%  

**$^1$H NMR**  
$\delta_H$ (500 MHz; C$\textsubscript{6}$D$\textsubscript{6}$)  7.33 (d, $J = 7.9$, 2H), 7.0-7.2 (m, 8H), 6.22 (s, 1H), 5.05 (s, 1H), 4.94 (s, 1H), 2.67 (t, $J = 7.6$, 2H), 2.39 (t, $J = 7.6$, 2H), 2.08 (s, 3H).

**$^{13}$C NMR**  
$\delta_C$ (125 MHz; C$\textsubscript{6}$D$\textsubscript{6}$) 146.2, 144.6, 142.4, 138.0, 129.1, 129.1, 128.9, 128.8, 127.6, 126.6, 126.4, 114.8, 40.2, 35.6, 18.0.

**HRMS**  
(EI) $m/z$ 401.3221 [calc'd for C$\textsubscript{26}$H$\textsubscript{44}$OSi ($M^+$) 401.3240].

**IR**  
(film) $\nu_{\text{max}} = 2971, 2933, 2890, 1792, 1494, 1448, 1232, 1164$.

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**Entry 10:**  
Recovered 64 mg, 88%  

**$^1$H NMR**  
$\delta_H$ (500 MHz; C$\textsubscript{6}$D$\textsubscript{6}$) 8.00 (d, 2H, $J = 8.4$), 7.28 (m, 2H), 7.18 (m, 3H), 7.07 (d, 2H, $J = 8.4$), 6.16 (s, 1H), 5.18 (s, 1H), 5.01 (s, 1H), 2.76 (t, 2H, $J = 8.1$), 2.48 (t, 2H, $J = 8.1$), 1.98 (s, 1H).

**$^{13}$C NMR**  
$\delta_C$ (125 MHz; C$\textsubscript{6}$D$\textsubscript{6}$) 149.7, 147.1, 145.3, 141.6, 135.6, 131.9, 128.9, 128.7, 126.5, 126.4, 123.6, 115.6, 39.3, 35.2, 17.2.
**HRMS** (EI) m/z 293.1413 [calc’d for C_{19}H_{19}NO_2 (M+) 293.1416].

**IR** (film) ν_{max} = 3085, 3027, 2930, 2858, 1623, 1453, 1343, 1109, 855, 824, 752, 699.

Entry 11

Recovered 37 mg, 68%

**\^1H NMR** δ\_H (500 MHz; C\_6D\_6) major isomer (E) 87% : 7.87 (d, 2H, J = 8.8), 6.94 (d, 2H, J = 8.8), 6.07 (s, 1H), 5.09 (q, 1H, J = 1.6), 4.89 (s, 1H), 2.03 (q, 2H, J = 8.5), 1.88 (d, 1H, J = 1.6), 0.96 (t, 3H, J = 8.5).

δ\_H (500 MHz; C\_6D\_6) minor isomer (Z) 13% : 7.79 (d, 2H, J = 8.7), 6.83 (d, 2H, J = 8.7), 5.85 (s, 1H), 4.76 (q, 1H, J = 1.7), 4.58 (s, 1H), 1.78 (q, 2H, J = 7.5), 1.75 (d, 1H, J = 1.7), 0.85 (t, 3H, J = 7.5).

**\^13C NMR** δ\_C (125 MHz; C\_6D\_6) 149.8, 147.6, 147.1, 135.3, 132.1, 126.5, 123.5, 113.9, 30.5, 17.1, 13.1.

**LRMS** m/z (CI) 217.0 (M\(^+\)).

**IR** (film) ν_{max} = 2966, 2940, 1593, 1518, 1342, 1109, 855, 697.

Entry 12: Recovered 44 mg, 78%
$^{1}$H NMR \( \delta_H \) (500 MHz; C$_6$D$_6$) 7.22 (d, 2H, \( J = 7.9 \)), 7.12 (d, 2H, \( J = 7.9 \)), 5.76 (s, 1H), 5.19 (s, 1H), 5.10 (s, 1H), 3.50 (s, 2H), 2.24 (s, 3H), 1.90 (d, 2H, \( J = 7.3 \)), 1.70 (m, 1H), 1.79 (s, 3H), 0.88 (d, 6H, \( J = 6.6 \)).

$^{13}$C NMR \( \delta_c \) (125 MHz; C$_6$D$_6$) 145.9, 137.9, 137.0, 135.5, 129.4, 129.3, 127.4, 114.4, 50.4, 44.4, 26.4, 22.5, 21.1, 18.0.

LRMS \( m/z \) (CI) 228.0 (M$^+$).

HRMS (EI) \( m/z \) 228.1881 [calc’d for C$_{17}$H$_{24}$ (M$^+$) 228.1878].

IR (film) \( \nu_{\text{max}} = 2953, 2923, 2868, 1513, 1463, 1108, 895, 803. \)

Entry 13: Recovered 41 mg, 75%

$^{1}$H NMR \( \delta_H \) (500 MHz; C$_6$D$_6$) 7.10 (dd, 2H, \( J = 5.7, 8.8 \)), 6.67 (t, 2H, \( J = 8.8 \)), 5.77 (m, 1H), 5.27 (1H, d, \( J = 1.7 \)), 4.92 (t, 1H, \( J = 1.9 \)), 1.77 (dd, 2H, \( J = 1.1, 7.3 \)), 1.57 (m, 1H), 1.46 (d, 3H, \( J = 1.2 \)), 0.74 (d, 6H, \( J = 6.8 \)).

$^{13}$C NMR \( \delta_c \) (125 MHz; C$_6$D$_6$) 161.9, 144.8, 139.9, 137.8, 128.3, 126.4, 115.4, 114.1, 50.1, 26.5, 22.6, 17.9.

LRMS \( m/z \) (CI) 218.3 (M$^+$).

HRMS (EI) \( m/z \) 218.1875 [calc’d for C$_{15}$H$_{19}$F (M$^+$) 218.1871].

IR (film) \( \nu_{\text{max}} = 2953, 2920, 2869, 1602, 1232, 1158, 838. \)

Spectroscopic Data For Substrates and Related Compounds:
**1H NMR**
\[ \delta_{\text{H}} (500 \text{ MHz; C}_6\text{D}_6) \]
- 2.46 (brs, 1H), 2.14 (m, 1H), 1.94 (m, 1H), 1.83 (m, 1H), 1.69 (m, 1H), 1.50 (m, 1H), 1.49 (s, 3H), 1.15-1.35 (m, 6H).

**13C NMR**
\[ \delta_{\text{C}} (125 \text{ MHz; C}_6\text{D}_6) \]
- 87.9, 71.9, 70.8, 48.8, 27.9, 27.6, 27.5, 26.7, 26.6, 26.5.

**LRMS**
- \( m/z \) (Cl) 152.3 (M+).

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**1H NMR**
\[ \delta_{\text{H}} (500 \text{ MHz; CDCl}_3) \]
- 8.07 (d, 2H, \( J = 8.9 \)), 7.73 (d, 2H, \( J = 9.0 \)), 3.09 (1H, s), 2.67 (1H, s), 1.70 (3H, s).

**13C NMR**
\[ \delta_{\text{C}} (125 \text{ MHz; CDCl}_3) \]
- 156.2, 147.7, 126.5, 124.0, 86.4, 74.5, 69.7, 33.7.

**HRMS**
- (EI) \( m/z \) 191.0580 [calc’d for C\(_{10}\)H\(_9\)NO\(_3\) (M+) 191.0582].

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**1H NMR**
\[ \delta_{\text{H}} (500 \text{ MHz; C}_6\text{D}_6) \]
- 5.73 (m, 1H), 4.79 (m, 2H), 2.20 (m, 1H), 1.55-1.82 (m, 4H), 1.72 (s, 3H), 1.53 (d, 3H, \( J = 3.4 \)), 0.85-1.25 (m, 6H).

**13C NMR**
\[ \delta_{\text{C}} (125 \text{ MHz; C}_6\text{D}_6) \]
- 208.4, 169.5, 96.0, 84.4, 77.9, 28.4, 27.7, 27.3, 27.2, 27.1, 22.2, 20.1.

**HRMS**
- (EI) \( m/z \) 208.1466 [calc’d for C\(_{13}\)H\(_{20}\)O\(_2\) (M+) 208.1463].
IR (film) $\nu_{\text{max}} = 2987, 2931, 2854, 1957, 1741, 1451, 1366, 1245, 1089, 1015, 843.$

![Chemical structure]

$^1$H NMR $\delta$ (500 MHz; C$_6$D$_6$) 7.92 (d, 2H, $J = 8.0$), 7.16 (d, 2H, $J = 8.0$), 6.03 (t, 1H, $J = 5.3$), 4.72 (m, 2H), 1.75 (s, 3H), 1.65 (s, 3H).

$^{13}$C NMR $\delta$ (125 MHz; C$_6$D$_6$) 203.4, 168.6, 147.2, 125.7, 123.6, 95.4, 80.6, 78.7, 27.7, 21.3.

HRMS (EI) $m/z$ 270.0735 [calc’d for C$_{15}$H$_{12}$NO$_4$ (M$^+$) 270.0766].

$^1$H NMR $\delta$ (500 MHz; CDCl$_3$) 5.22 (t, 1H, $J = 6.5$), 4.83 (d, 2H, $J = 6.5$), 3.66 (s, 1H), 1.81 (m, 2H), 1.75 (m, 2H), 1.63 (m, 1H), 1.35 (tt, 1H, $J = 12.0$, $J = 3.1$), 1.23-1.13 (m, 2H), 1.23 (s, 3H), 1.10 (tt, 1H, $J = 12.6$, $J = 3.5$), 0.98 (ddd, 2H, $J = 9.7$, $J = 6.6$, $J = 3.5$).

$^{13}$C NMR $\delta$ (125 MHz; CDCl$_3$) 205.7, 98.3, 78.0, 73.3, 67.0, 48.7, 27.3, 26.4, 25.0.

LRMS $m/z$ (Cl) 166.4 (M$^+$).

IR (film) $\nu_{\text{max}} = 3385, 2982, 2853, 1956, 1451, 1376, 1130, 1066, 928, 840.$
$^{1}H$ NMR $\delta_{H} (500 \text{ MHz}; \text{CDCl}_3)$ 7.41 (d, 2H, $J$ = 8), 7.25 (t, 2H, $J$ = 8), 7.16 (t, 1H, $J$ = 8), 5.46 (t, 1H, $J$ = 6.6), 4.87 (dd, 1H, $J$ = 10.7, $J$ = 6.6), 4.85 (dd, 1H, $J$ = 10.7, $J$ = 6.6), 2.50 (s, 1H), 1.56 (s, 3H).

$^{13}C$ NMR $\delta_{c}$ (125 MHz; CDCl$_3$) 205.8, 147.1, 128.1, 126.9, 124.9, 100.1, 78.9, 72.9, 30.3.

LRMS $m/z$ (CI) (M$^+$) 160.0.

$^{1}H$ NMR $\delta_{H} (500 \text{ MHz}; \text{C}_6\text{D}_6)$ 7.80 (d, 2H, $J$ = 8), 7.27 (t, 2H, $J$ = 8), 7.18 (t, 1H, $J$ = 8), 3.08 (s, 1H), 2.39 (s, 1H), 1.81 (s, 3H).

$^{13}C$ NMR $\delta_{c}$ (125 MHz; C$_6$D$_6$) 146.1, 128.4, 127.7, 125.3, 88.0, 72.9, 69.8, 33.7.

LRMS $m/z$ (CI) (M$^+$) 152.5.
**1H NMR**  
δ_H (500 MHz; C₆D₆) 5.20 (t, 1H, J = 6.5), 4.65 (d, 2H, J = 6.5), 1.80 (non, 1H, J = 6.3), 1.68 (br s, 1H), 1.45 (dd, 1H, J = 6, J = 13.9), 1.39 (dd, 1H, J = 6, J = 13.9), 1.23 (s, 3H), 0.96 (d, 3H, J = 3.5), 0.94 (d, 3H, J = 3.5).

**13C NMR**  
δ_c (125 MHz; C₆D₆) 205.8, 100.8, 78.1, 71.5, 51.5, 28.9, 24.8, 24.7.

**HRMS**  
(EI) m/z 140.1203 [calc’d for C₁₉H₁₆O (M+) 140.1201].

![Chemical structure](image)

**1H NMR**  
δ_H (500 MHz; C₆D₆) 5.84 (t, J = 6.9), 4.77 (dd, J = 6.9, 4.8), 1.8-2.0 (m, 3H), 1.79 (s, 3H) 1.66 (s, 3H), 1.01 (t, J = 5.8, 6H).

**13C NMR**  
δ_c (125 MHz; C₆D₆) 204.9, 195.4, 146.8, 136.1, 124.1, 99.5, 77.0, 71.6, 29.2, 24.7, 24.6.

**HRMS**  
(EI) m/z 182.2309 [calc’d for C₁₁H₁₈O₂ (M+) 182.1307].

**IR**  
(film) ν_max = 2958, 2922, 2871, 1956, 1741, 1643, 1466, 1367, 1245, 1202, 1134, 950, 847.