Supporting Information

Iron-Catalyzed Cyclopropanation with Glycine Ethyl Ester Hydrochloride in Water

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General procedure

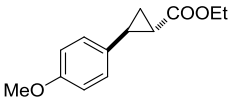
For flash chromatography technical grade solvents were used, which were distilled prior to use. Chromatographic purification was performed as flash chromatography using Brunschwig silica 32-63, 60Å, using pentane/diethylether as eluent with 0.3-0.5 bar pressure. TLC was performed on Merck silica gel 60 F254 TLC glass plates and visualized with UV light and potassium permanganate stain. ^{1}H-NMR spectra were recorded on a VARIAN Mercury 300 MHz spectrometer in chloroform-d, all signals are reported in ppm with the internal chloroform signal at 7.26 ppm as standard. The data is being reported as (s = singlet, d = doublet, t = triplet, m = multiplet or unresolved, br = broad signal, coupling constant(s) in Hz, integration). ^{13}C-NMR spectra were recorded with ^{1}H-decoupling on a Bruker 100 MHz spectrometer in chloroform-d, all signals are reported in ppm with the internal chloroform signal at 77.0 ppm as standard. Infrared spectra were recorded neat on a Perkin-Elmer spectrum RX-I FT-IR spectrometer. The data is reported as absorption maxima (n, cm^{-1}). Mass spectrometric measurements were performed by the mass spectrometry service of the LOC at the ETHZ on on a VG-TRIBRID for electron impact ionization (EI). Chemicals were purchased from Aldrich and used without further purification.

General procedure for Cyclopropanation with Different Catalysts and Glycine Ethyl Ester Hydrochloride: The catalyst was dissolved in p-methoxystyrene (29.5 μL, 0.22 mmol) in an open vial under air. To this mixture was added glycine ethyl ester hydrochloride (61 mg, 0.44, 2.0 equiv.), water (1.0 mL) and acetic acid (2.0 mg, 0.033 mmol, 0.15 equiv.). To this vigorously stirred heterogenous mixture was added $NaNO_2$ (36 mg, 0.53 mmol, 2.4 equiv.) in one portion at 40 °C. After 14 h, the mixture was diluted with water, extracted with CH_2Cl_2 (3x), dried over $MgSO_4$ and evaporated in vacuo. The crude product was then analyzed by ^{1}H-NMR analysis to determine the conversion and the dr.

General procedure for Cyclopropanation with Fe(TPP)Cl and Glycine Ethyl Ester Hydrochloride: FeTPPCl (7.0 mg, 0.01 mmol, 1 mol%) was dissolved in the substrate (1.0 mmol) in an open vial under air. To this mixture was then added glycine ethyl ester hydrochloride (279 mg, 2.0 mmol, 2.0 equiv.), water (5.0 mL) and acetic acid (10.0 mg, 0.15 mmol, 0.15 equiv.). To this vigorously stirred heterogenous mixture was added $NaNO_2$ (166 mg,

2.4 mmol, 2.4 equiv.) in one portion at 40 °C. After 14 h, the mixture was diluted with water, extracted with CH_2Cl_2 (3x), dried over $MgSO_4$ and evaporated in vacuo. The crude product was then analyzed by ^{1}H-NMR analysis to determine the conversion and the dr. It was further purified by flash chromatography to afford the pure *trans* product.

(1RS,2RS)-ethyl 2-(4-methoxyphenyl)cyclopropanecarboxylate (1)

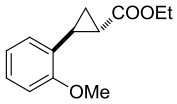


Was obtained as an amorphous solid (174 mg, 0.79 mmol, 79 %) following the general procedure.

^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.06–7.00 (m, 2H), 6.84–6.80 (m, 2H), 4.16 (q, *J* = 7.0 Hz, 2H), 3.78 (s, 3H), 2.52–2.44 (m, 1H), 1.82 (ddd, *J* = 4.3, 5.3, 8.5 Hz, 1H), 1.59–1.51 (m, 1H), 1.28 (t, *J* = 7.2 Hz, 3H), 1.26–1.21 (m, 1H).
^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.5, 158.3, 132.0, 127.3, 113.9, 60.6, 55.3, 25.6, 23.9, 16.7, 14.3.

Spectral data are in accordance with the literature.[1]

(1RS,2RS)-ethyl 2-(2-methoxyphenyl)cyclopropanecarboxylate (2)



Was obtained as an oil (154 mg, 0.70 mmol, 70 %) following the general procedure.

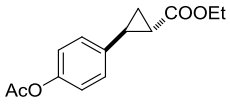
^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.18 (ddd, *J* = 8.1, 6.4, 2.8 Hz, 1H), 6.91–6.77 (m, 3H), 4.18 (q, *J* = 7.1 Hz, 2H), 3.84 (s, 3H), 2.74 (ddd, *J* = 9.2, 6.8, 4.4 Hz, 1H), 1.85 (ddd, *J* = 8.3, 5.2, 4.4 Hz, 1H), 1.55 (ddd, *J* = 9.3, 5.2, 4.3 Hz, 1H), 1.32–1.27 (m, 4H).
^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.9, 158.3, 128.4, 127.5, 125.9, 120.4, 110.4, 60.5, 55.5, 22.7, 21.2, 15.8, 14.3.

[1] *J. Org. Chem.* **2003**, *68*, 8179

HRMS (EI): calcd for $C_{13}H_{16}O_3^+$ (M^+) 220.1094, found 220.1092.

IR (neat): 2980, 1719, 1497, 1246, 1178.

(1RS,2RS)-ethyl 2-(4-acetoxyphenyl)cyclopropanecarboxylate (3)



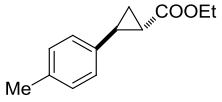
Was obtained as an oil (168 mg, 0.68 mmol, 68 %) following the general procedure.

^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.11 (d, *J* = 9.0 Hz, 2H), 6.99 (d, *J* = 8.7 Hz, 2H), 4.16 (q, *J* = 7.2 Hz, 2H), 2.51 (m, 1H), 2.29 (s, 3H), 1.87 (m, 1H), 1.59 (m, 1H), 1.25, (m, 1H), 1.28 (t, *J* = 7.2 Hz, 3H).

^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.2, 169.6, 149.1, 137.7, 127.2, 121.5, 60.7, 25.6, 24.1, 21.1,16.9, 14.2.

Spectral data are in accordance with the literature[1]

(1RS,2RS)-ethyl 2-(p-tolyl)cyclopropanecarboxylate (4)



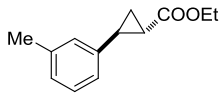
Was obtained as an oil (151 mg, 0.74 mmol, 74 %) following the general procedure.

^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.11 (d, *J* = 7.8 Hz, 2H), 7.01 (d, *J* = 8.1 Hz, 2H), 4.19 (q, *J* = 7.2 Hz, 2H), 2.51 (ddd, *J* = 9.3, 6.3, 4.2 Hz, 1H), 2.33 (s, 3H), 1.88 (ddd, *J* = 8.4, 5.1, 4.2 Hz, 1H), 1.59 (ddd, *J* = 9.0, 5.4, 4.5 Hz, 1H), 1.26-1.36 (m, 1H), 1.30 (t, *J* = 7.2 Hz, 3H).

^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.5, 137.0, 136.0, 129.1, 126.0, 60.6, 25.9, 24.0, 20.9, 16.9, 14.2.

Spectral data are in accordance with the literature.[1]

(1RS,2RS)-ethyl 2-(m-tolyl)cyclopropanecarboxylate (5)

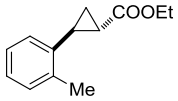


Was obtained as an oil (130 mg, 0.64 mmol, 64 %) following the general procedure.

^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.23–6.92 (m, 4H), 4.21 (q, *J* = 7.2 Hz, 2H), 2.52 (ddd, *J* = 9.3, 6.3, 4.2 Hz, 1H), 2.36 (s, 3H), 1.93 (ddd, *J* = 8.4, 5.1, 3.9 Hz, 1H), 1.62 (m, 1H), 1.28-1.39 (m, 1H), 1.31 (t, *J* = 7.2 Hz, 3H).
^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.4, 140.0, 138.0, 128.3, 127.2, 126.9, 123.1, 60.6, 26.1, 24.1, 21.3, 17.0, 14.2.

Spectral data are in accordance with the literature.[1]

(1RS,2RS)-ethyl 2-(o-tolyl)cyclopropanecarboxylate (6)

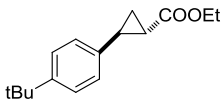


Was obtained as an oil (126 mg, 0.62 mmol, 62 %) following the general procedure.

^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.22–7.00 (m, 4H), 4.22 (q, *J* = 7.2 Hz, 2H), 2.54 (ddd, *J* = 9.0, 6.6, 4.2 Hz, 1H), 2.41 (s, 3H), 1.81 (m, 1H), 1.60 (m, 1H), 1.24-1.40 (m, 1H), 1.32 (t, *J* = 7.2 Hz, 3H).
^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.8, 137.9, 137.8, 129.8, 126.6, 125.8 (2C), 60.6, 24.6, 22.3, 19.5, 15.3, 14.3.

Spectral data are in accordance with the literature.[1]

(1RS,2RS)-ethyl 2-(4-(tert-butyl)phenyl)cyclopropanecarboxylate (7)

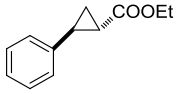


Was obtained as an oil (178 mg, 0.72 mmol, 72 %) following the general procedure with glycine ethyl ester hydrochloride (3.0 equiv.), $NaNO_2$ (3.6 equiv.) and FeTPPCl (1.5 mol%).

^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.34 (d, *J* = 8.4 Hz, 2H), 7.09 (d, *J* = 8.1 Hz, 2H), 4.21 (q, *J* = 7.2 Hz, 2H), 2.54 (ddd, *J* = 9.0, 6.9, 4.5 Hz, 1H), 1.94 (ddd, *J* = 8.4, 5.1, 4.2 Hz, 1H), 1.63 (m, 1H), 1.34-1.38 (m, 1H), 1.35 (s, 9H), 1.32 (t, *J* = 7.2 Hz, 3H).
^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.4, 149.3, 137.0, 125.7, 125.3, 60.5, 34.4, 31.3, 25.8, 24.1, 16.9, 14.2.

Spectral data are in accordance with the literature.[1]

(1RS,2RS)-ethyl 2-phenylcyclopropanecarboxylate (8)

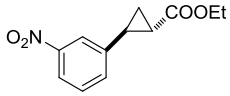


Was obtained as an oil (135 mg, 0.71 mmol, 71 %) following the general procedure.

^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.33–7.11 (m, 5H), 4.19 (q, *J* = 7.2 Hz, 2H), 2.52 (ddd, *J* = 9.6, 6.3, 4.5 Hz, 1H), 1.91 (m, 1H), 1.61 (m, 1H), 1.28-1.38 (m, 1H), 1.29 (t, *J* = 7.2 Hz, 3H).
^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.6, 140.4, 128.7, 126.7, 126.4, 60.9, 26.4, 24.4, 17.3, 14.5.

Spectral data are in accordance with the literature.[1]

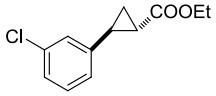
(1RS,2RS)-ethyl 2-(3-nitrophenyl)cyclopropanecarboxylate (9)



Was obtained as an oil (155 mg total, 83 % purity (17% diethyl maleate), 129 mg, 0.55 mmol, 55%) following the general procedure with glycine ethyl ester hydrochloride (3.0 equiv.), $NaNO_2$ (3.6 equiv.) and FeTPPCl (1.5 mol%). The $NaNO_2$ was added as an aqueous solution over 10 h.

^{1}H-NMR (300 Mhz, $CDCl_3$): 8.11–7.96 (m, 1H), 7.91 (dd, *J* = 1.4, 0.9 Hz, 1H), 7.43 (dt, *J* = 3.3, 0.9 Hz, 2H), 4.17 (q, *J* = 7.1 Hz, 2H), 2.60 (ddd, *J* = 9.6, 6.4, 4.2 Hz, 1H), 1.96 (dddd, *J* = 8.5, 5.2, 4.2, 0.9 Hz, 1H), 1.84–1.59 (m, 1H), 1.41–1.33 (m, 1H), 1.28 (t, *J* = 7.1 Hz, 3H).
^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 172.6, 148.5, 142.4, 132.7, 129.4, 121.5, 120.9, 61.02, 25.4, 24.5, 17.1, 14.2.
HRMS (EI): calcd for $C_{12}H_{13}NO_4^+$ (M^+) 235.0839, found 235.0843.
IR (neat): 2983, 1720, 1528, 1348, 1179.

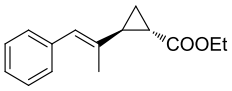
(1RS,2RS)-ethyl 2-(3-chlorophenyl)cyclopropanecarboxylate (10)



Was obtained as an oil (150 mg, 0.67 mmol, 67 %) following the general procedure with glycine ethyl ester hydrochloride (4.0 equiv.), $NaNO_2$ (4.8 equiv.).

^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.24–7.11 (m, 2H), 7.06 (dd, *J* = 2.9, 0.8 Hz, 1H), 6.98 (dt, *J* = 6.8, 1.9 Hz, 1H), 4.17 (q, *J* = 7.1 Hz, 2H), 2.48 (ddd, *J* = 9.2, 6.5, 4.2 Hz, 1H), 1.90 (ddd, *J* = 8.5, 5.4, 4.2 Hz, 1H), 1.67–1.51 (m, 1H), 1.32–1.26 (m, 4H).
^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.0, 142.3, 134.4, 129.7, 126.7, 126.4, 124.5, 60.9, 25.6, 24.2, 17.0, 14.3.
HRMS (EI): calcd for $C_{12}H_{13}ClO_2^+$ (M^+) 224.0599, found 224.0599.
IR (neat): 2981, 1720, 1325, 1178, 779.

(1RS,2RS)-ethyl 2-((E)-1-phenylprop-1-en-2-yl)cyclopropanecarboxylate (11)



Was obtained as an oil (89 mg, 0.39 mmol, 39 %) following the general procedure with glycine ethyl ester hydrochloride (3.0 equiv.), $NaNO_2$ (3.6 equiv.) and FeTPPCl (1.5 mol%). The $NaNO_2$ was added as an aqueous solution over 10 h.

^{1}H-NMR (300 Mhz, $CDCl_3$): δ = 7.36–7.27 (m, 2H), 7.25–7.14 (m, 3H), 6.39 (s, 1H), 4.17 (q, *J* = 7.2 Hz, 2H), 2.43–1.99 (m, 1H), 1.81 (ddd, *J* = 8.5, 5.1, 4.4 Hz, 1H), 1.76 (d, *J* = 1.3 Hz, 1H), 1.37 (dd, *J* = 9.1, 4.5 Hz, 1H), 1.29 (t, *J* = 7.1 Hz, 3H), 1.25–1.17 (m, 1H).

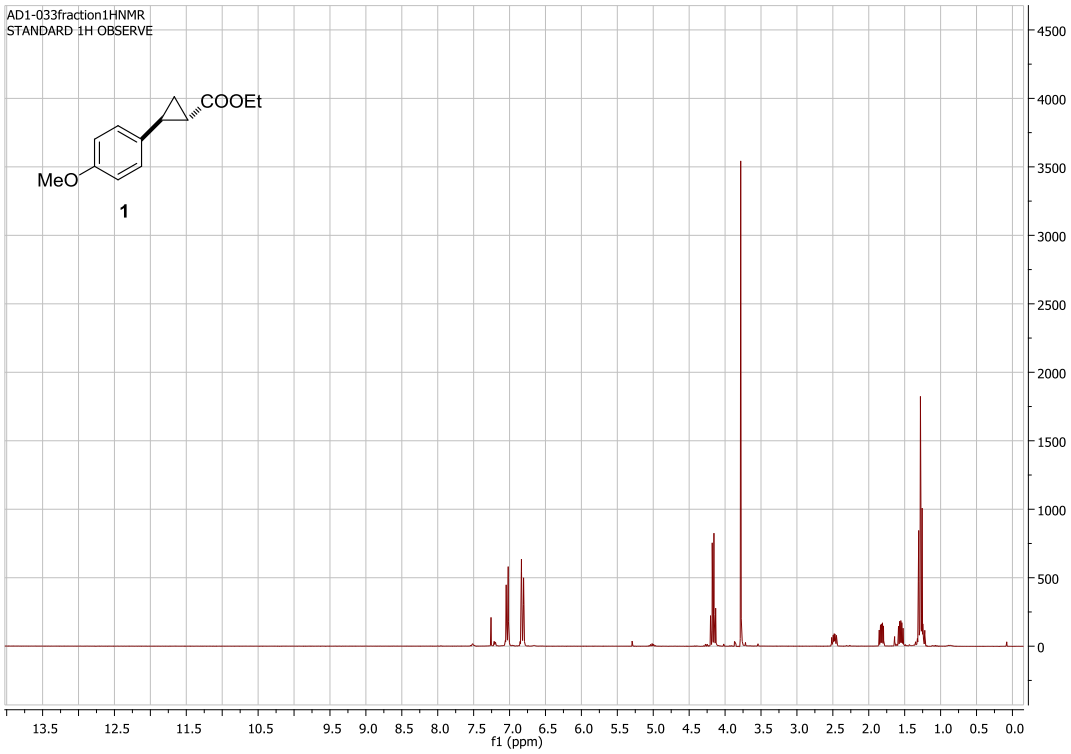
^{13}C-NMR (100 Mhz, $CDCl_3$): δ = 173.9, 137.8, 135.8, 128.8, 128.1, 126.2, 125.9, 60.6, 30.7, 20.4, 15.5, 14.3, 14.0.

HRMS (EI): calcd for $C_{15}H_{18}O_2^+$ (M^+) 230.1302, found 230.1299.

IR (neat): 2981, 1720, 1318, 1175, 697.

[1]: *J. Org. Chem.* **2003**, *68*, 8179.

Spectra: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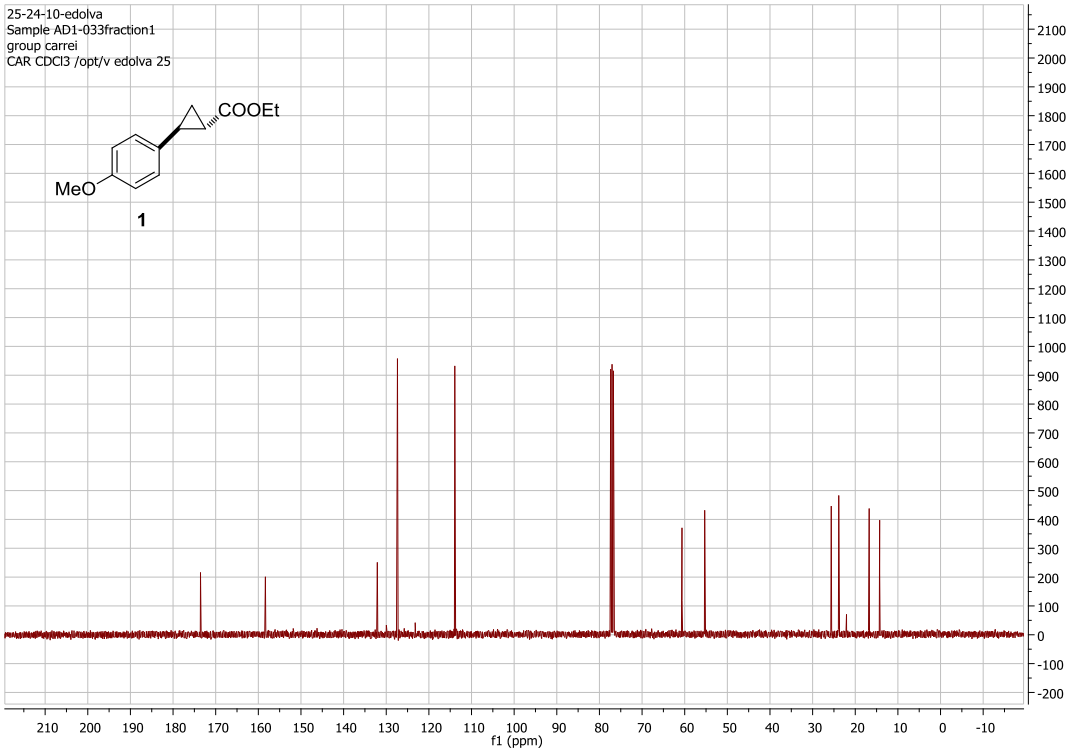
MeO
1
f1 (ppm)


25-24-10-edolva
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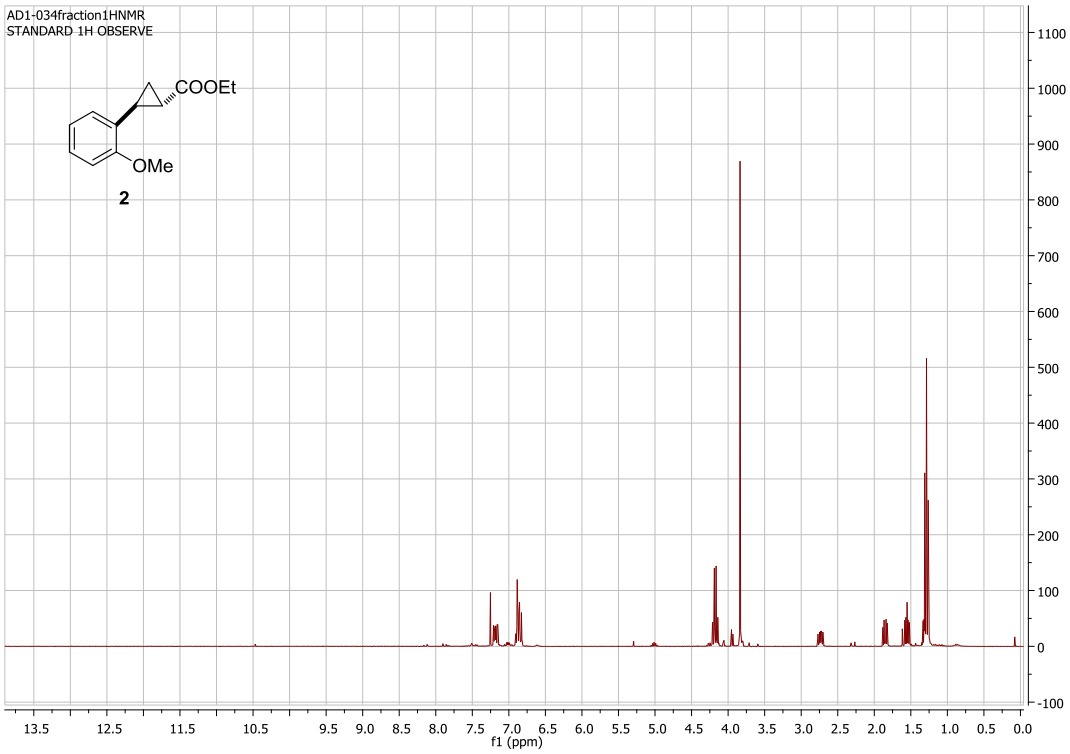
COOEt
MeO
1
f1 (ppm)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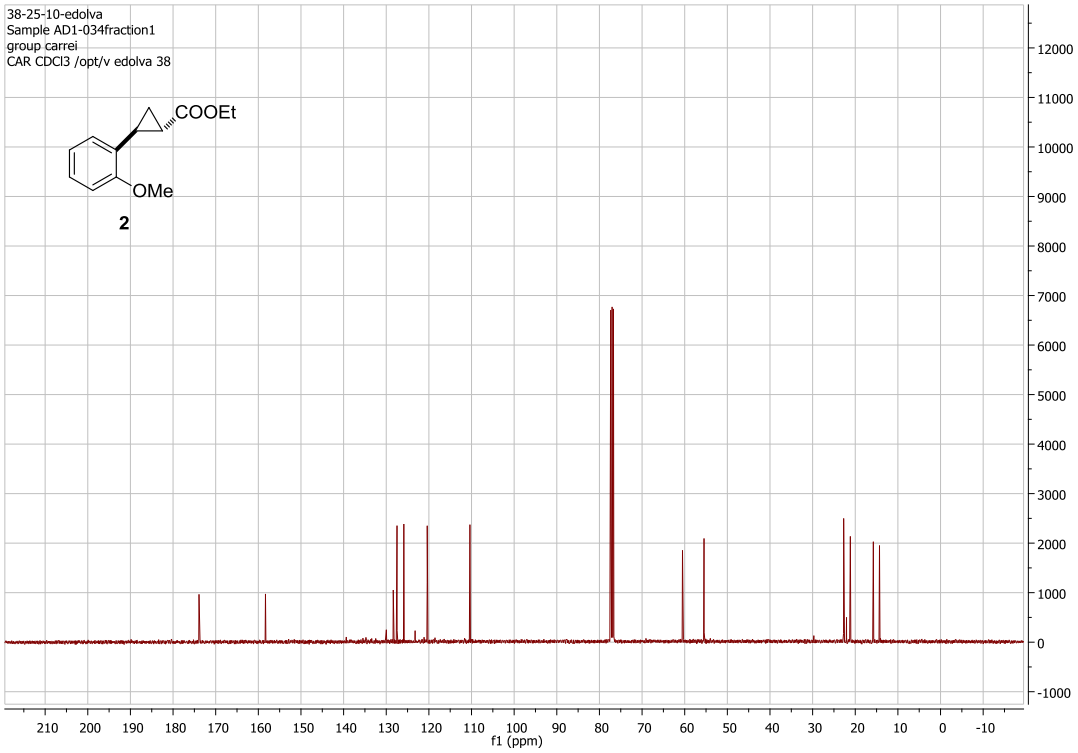
COOEt
OMe
2
f1 (ppm)


38-25-10-edolva
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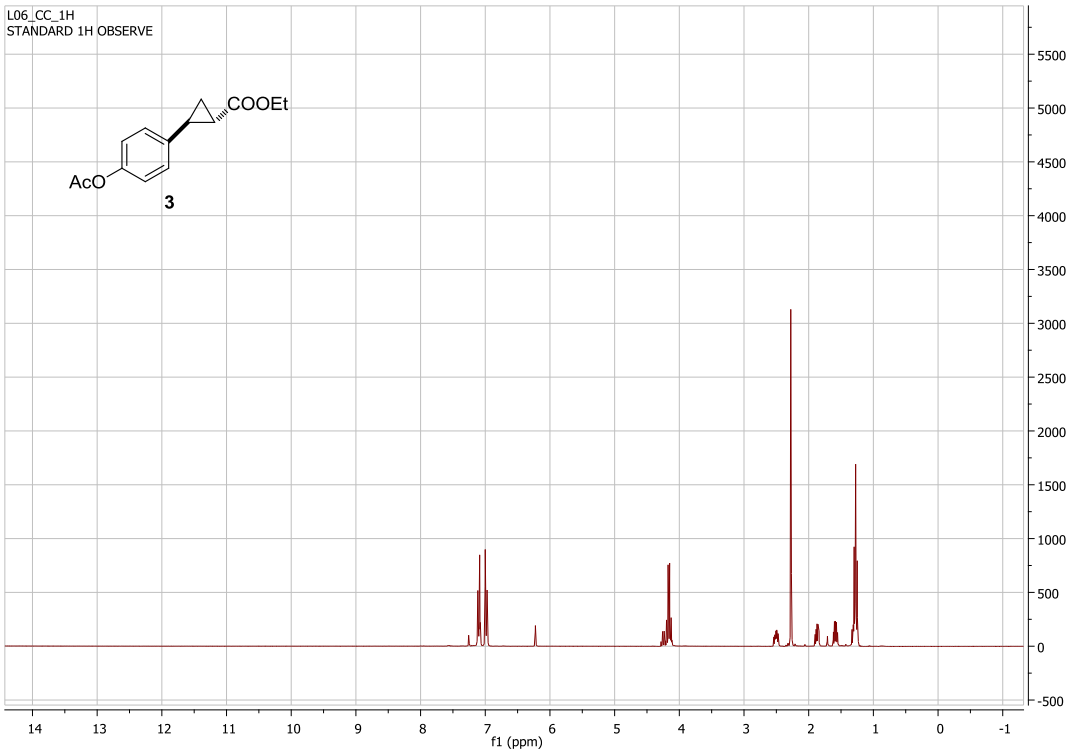
OMe
2
f1 (ppm)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AcO
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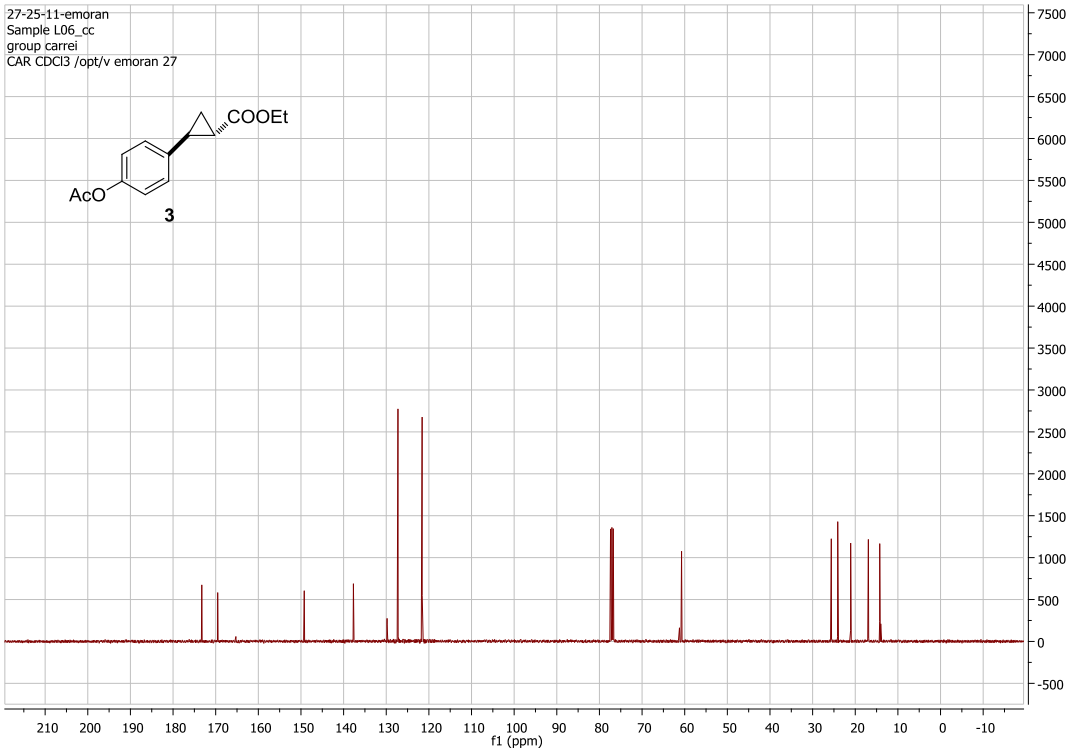
f1 (ppm)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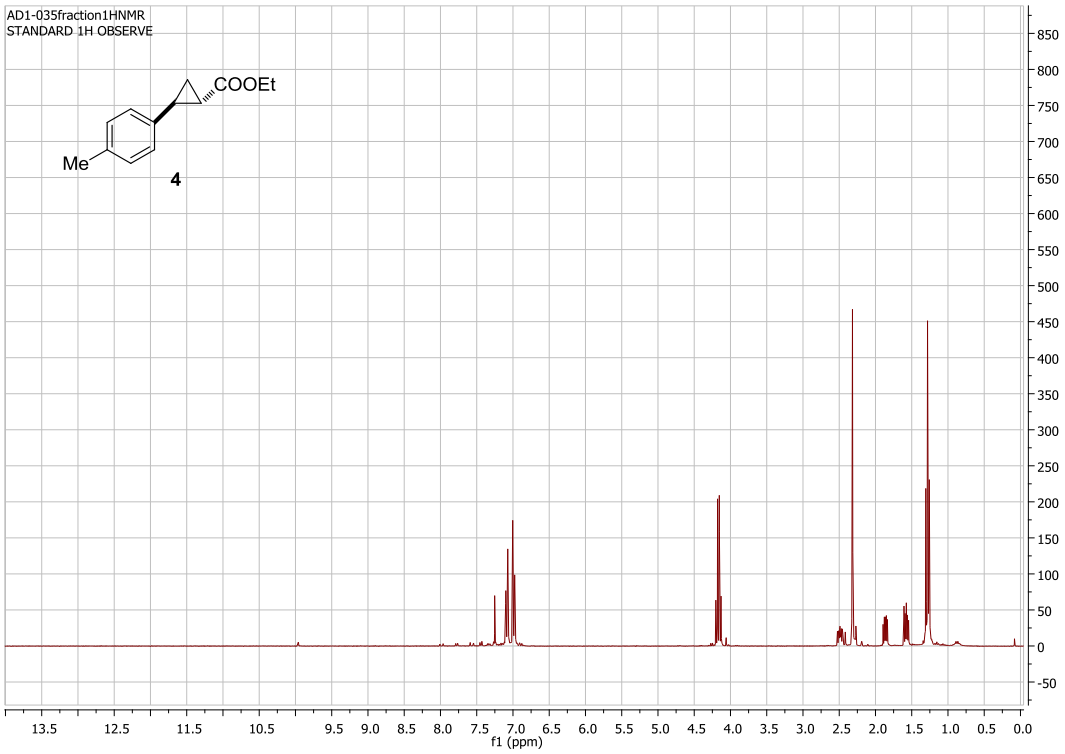
f1 (ppm)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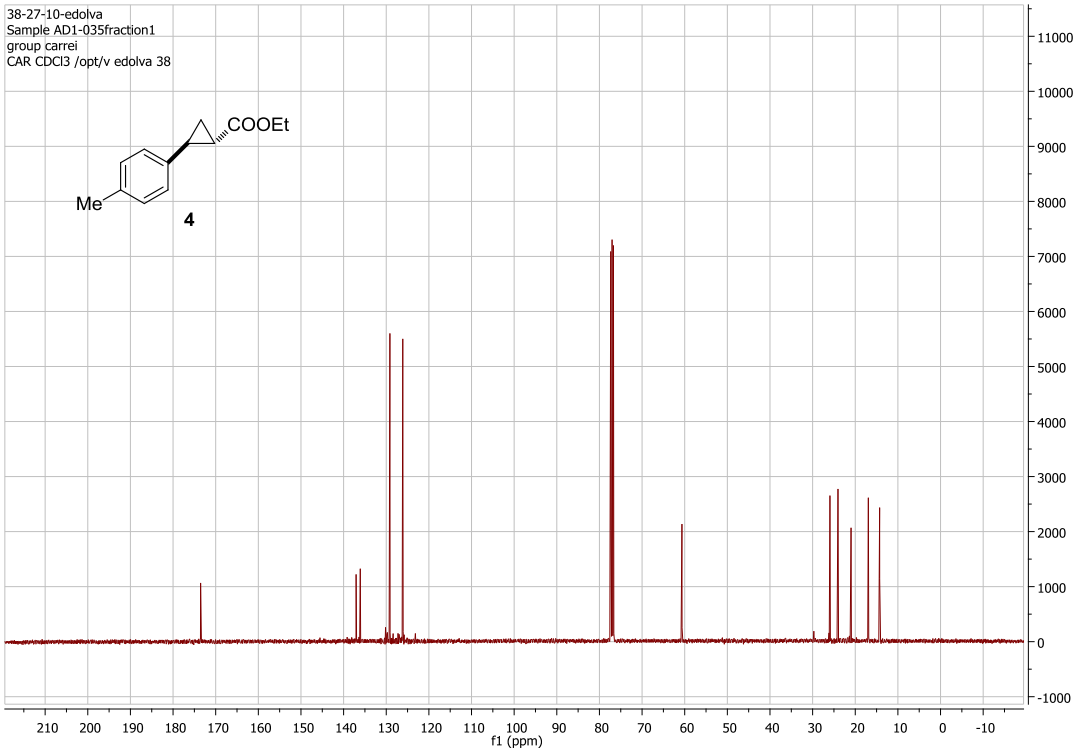
f1 (ppm)


38-27-10-edolva
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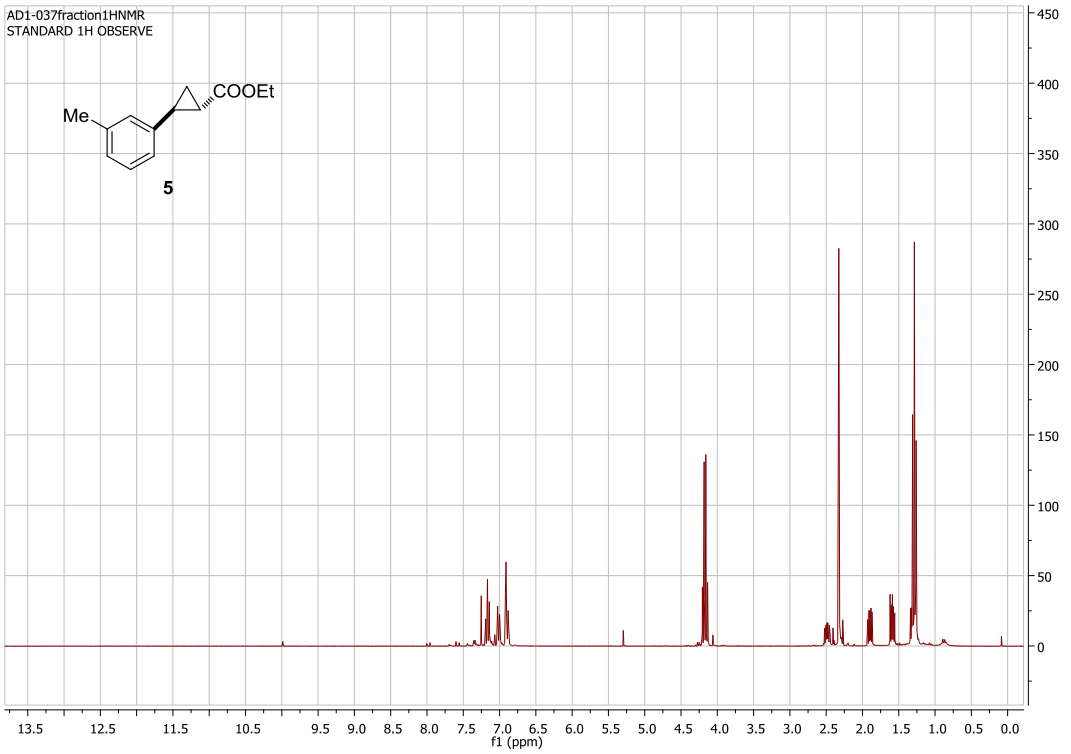
group carrei
CAR CDCl3 /opt/v edolva 38
COOEt
Me
4
f1 (ppm)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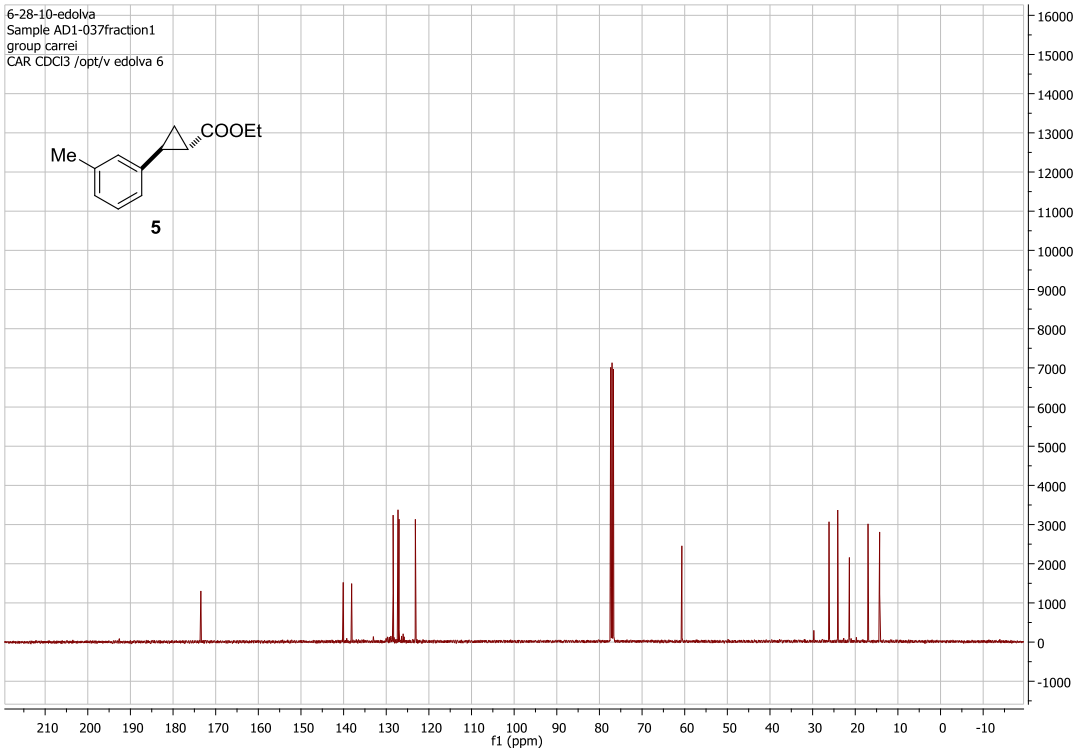
Me
COOEt
5
f1 (ppm)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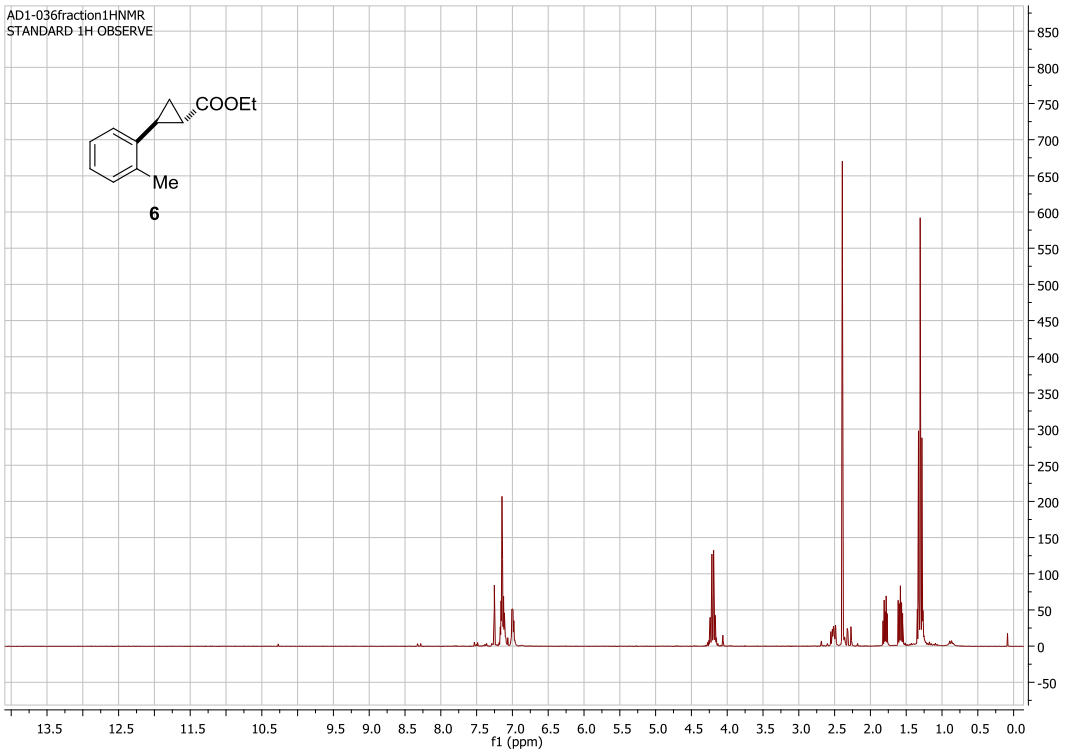
group carrei
CAR CDCl3 /opt/v edolva 6
Me
COOEt
5
f1 (ppm)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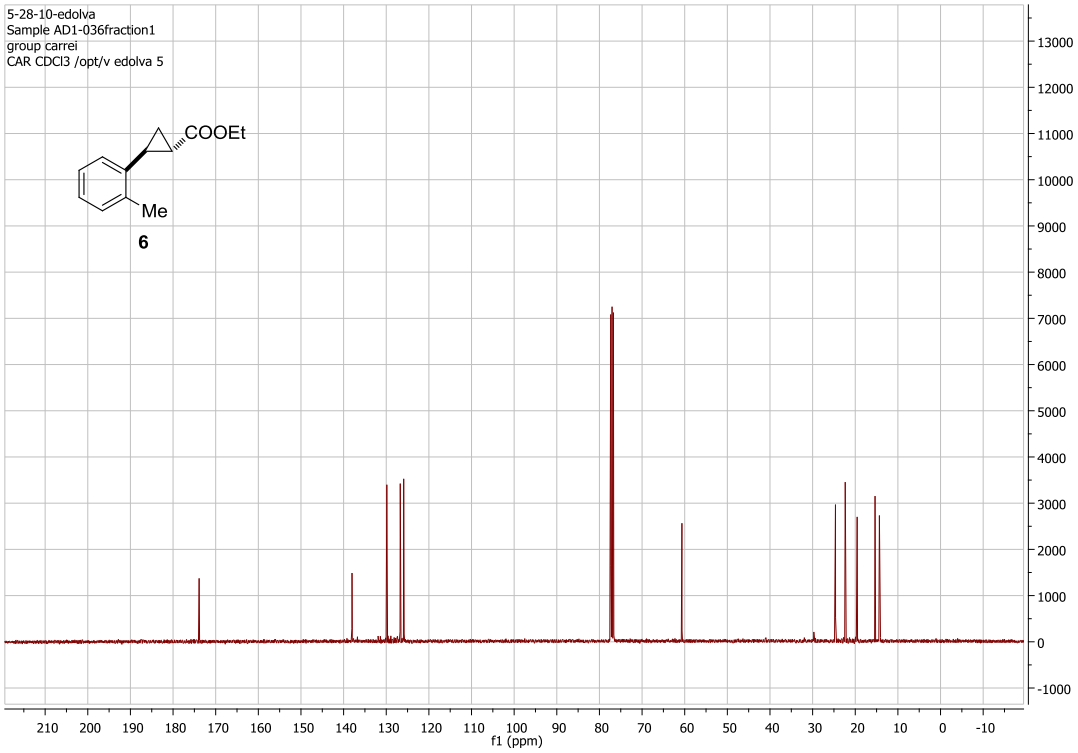
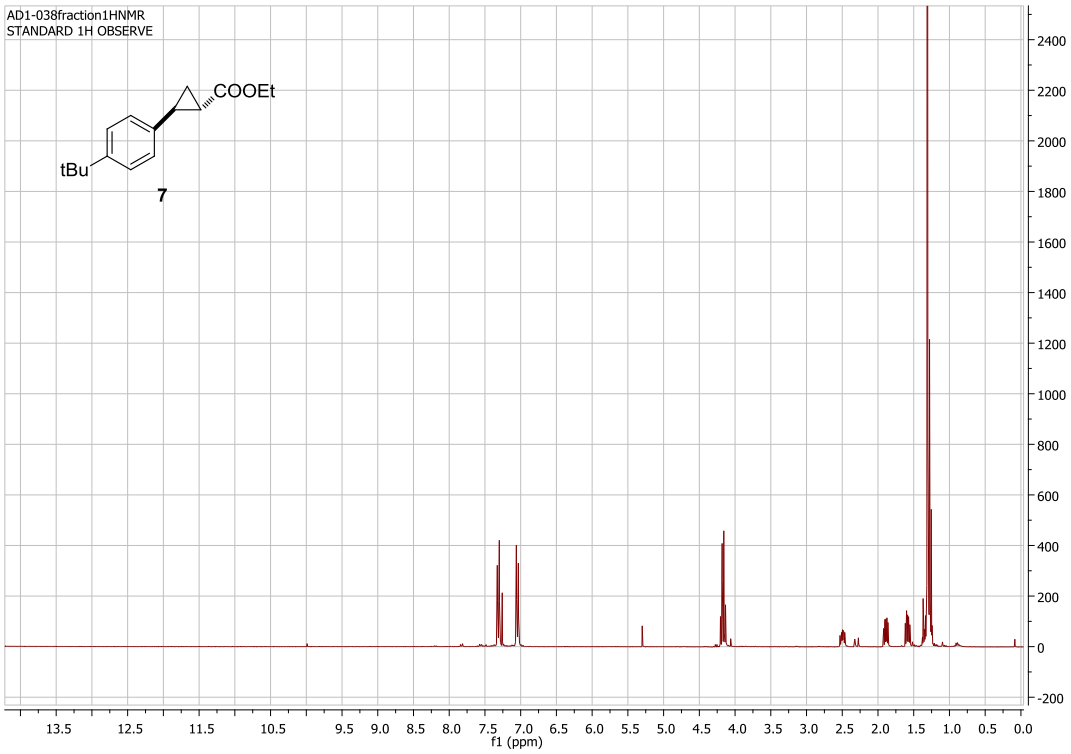
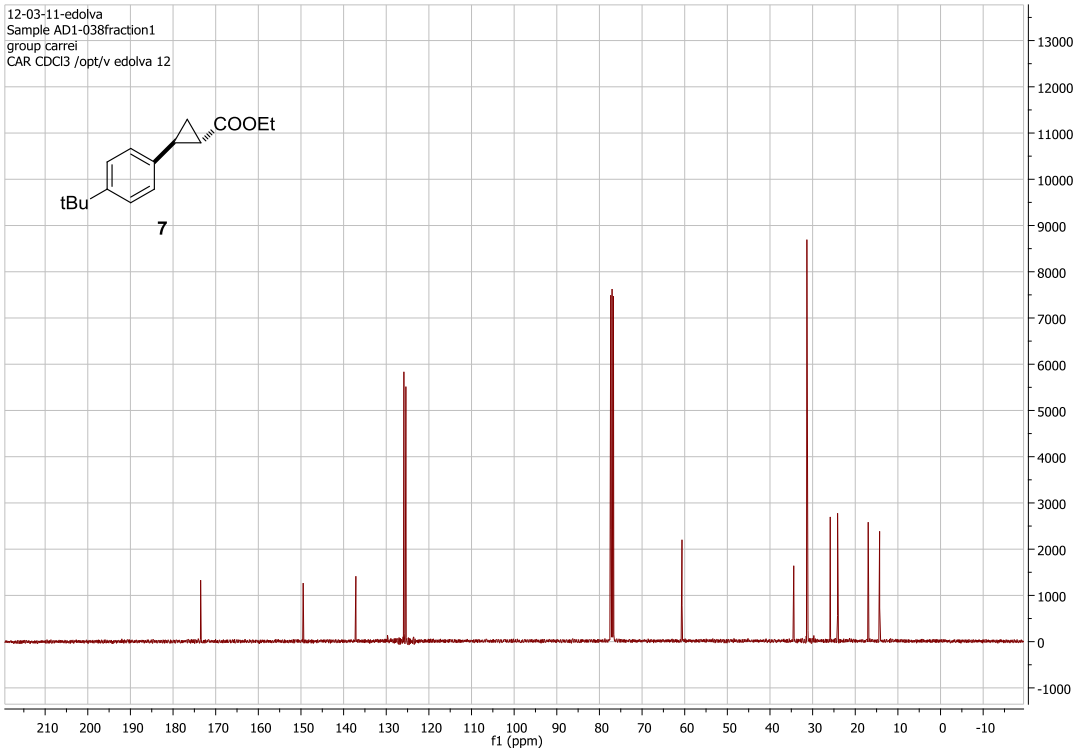
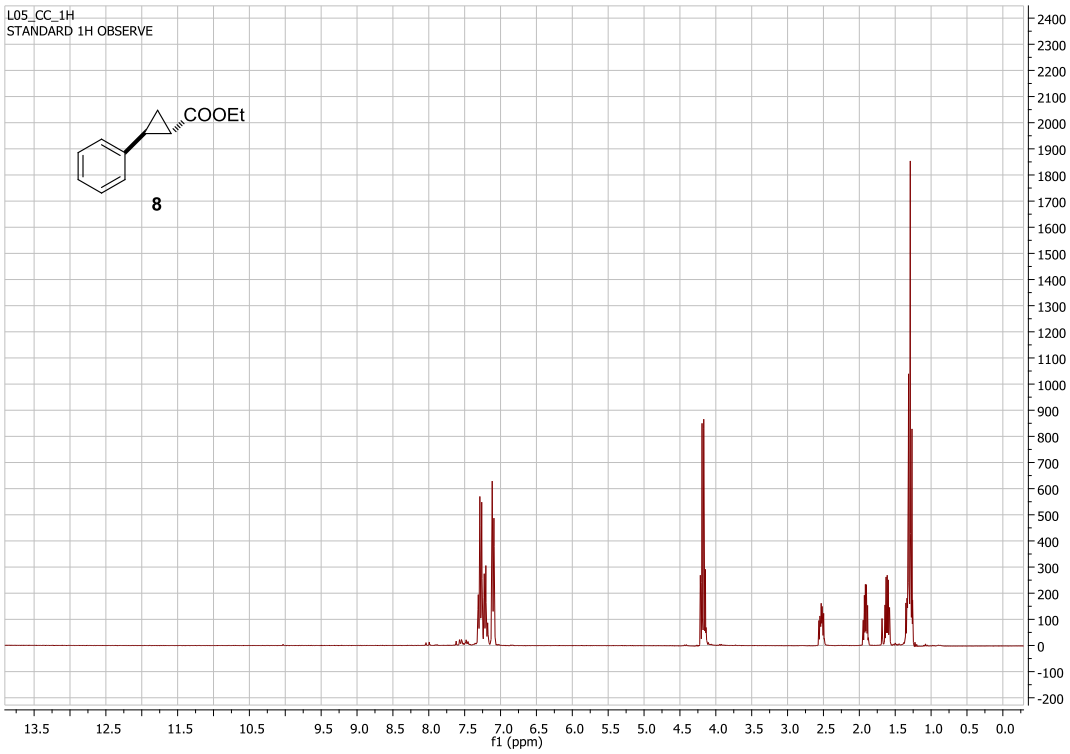
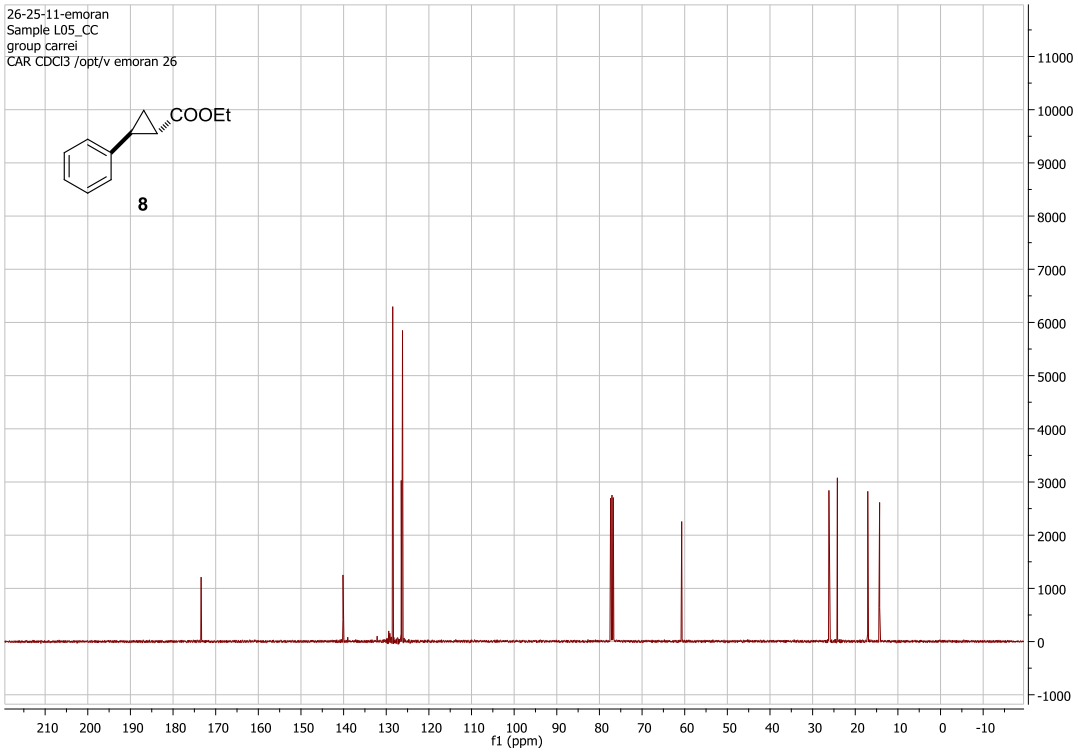
COOEt
Me
6
f1 (ppm)

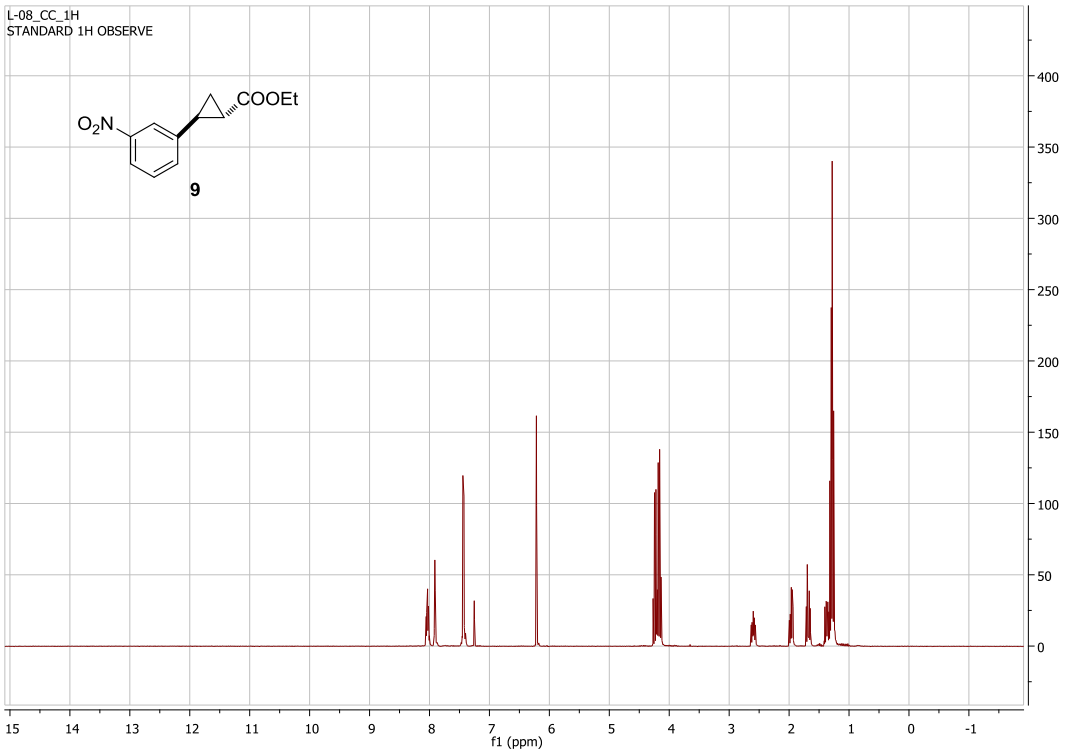

5-28-10-edolva
Sample AD1-036fraction1
group carrei
CAR CDCl3 /opt/v edolva 5
COOEt
Me
6
f1 (ppm)

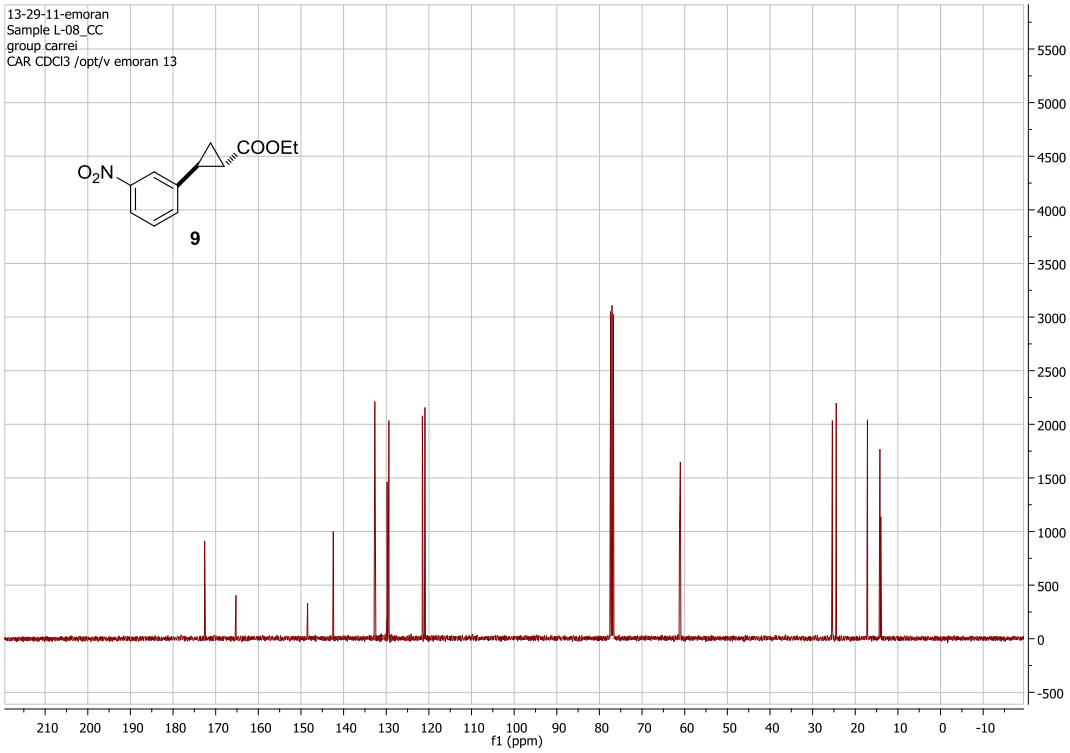

AD1-038fraction1HNMR
STANDARD 1H OBSERVE
COOEt
tBu
7
f1 (ppm)

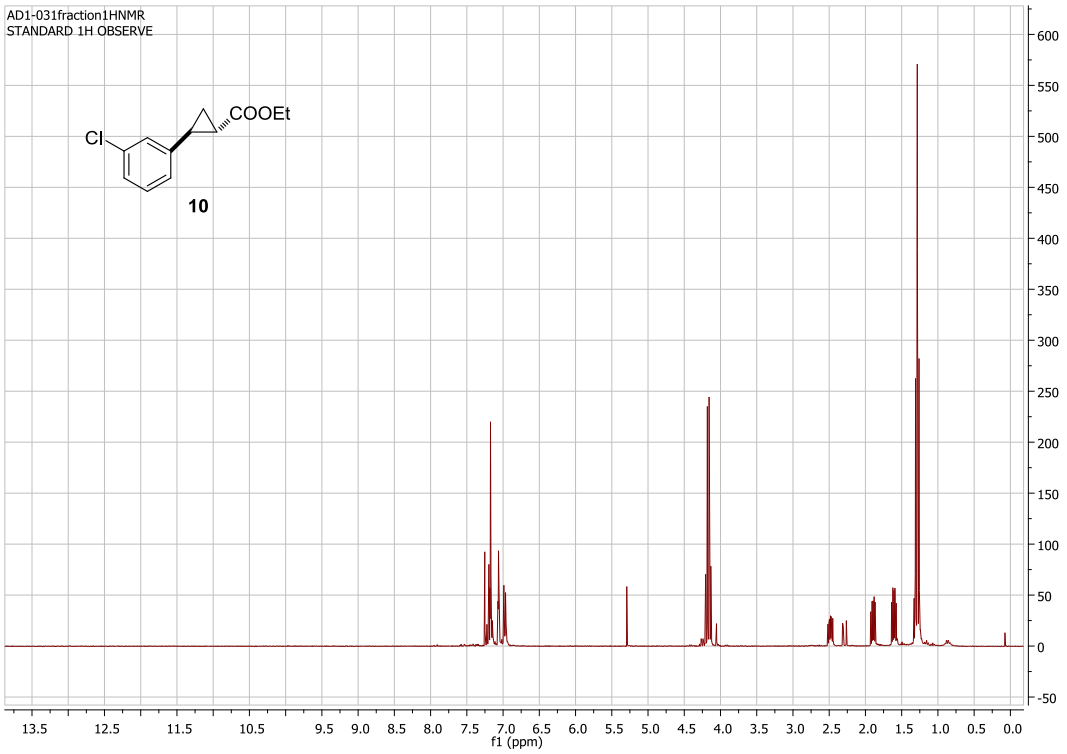

12-03-11-edolva
Sample AD1-038fraction1
group carrei
CAR CDCl3 /opt/v edolva 12
COOEt
tBu
7
f1 (ppm)

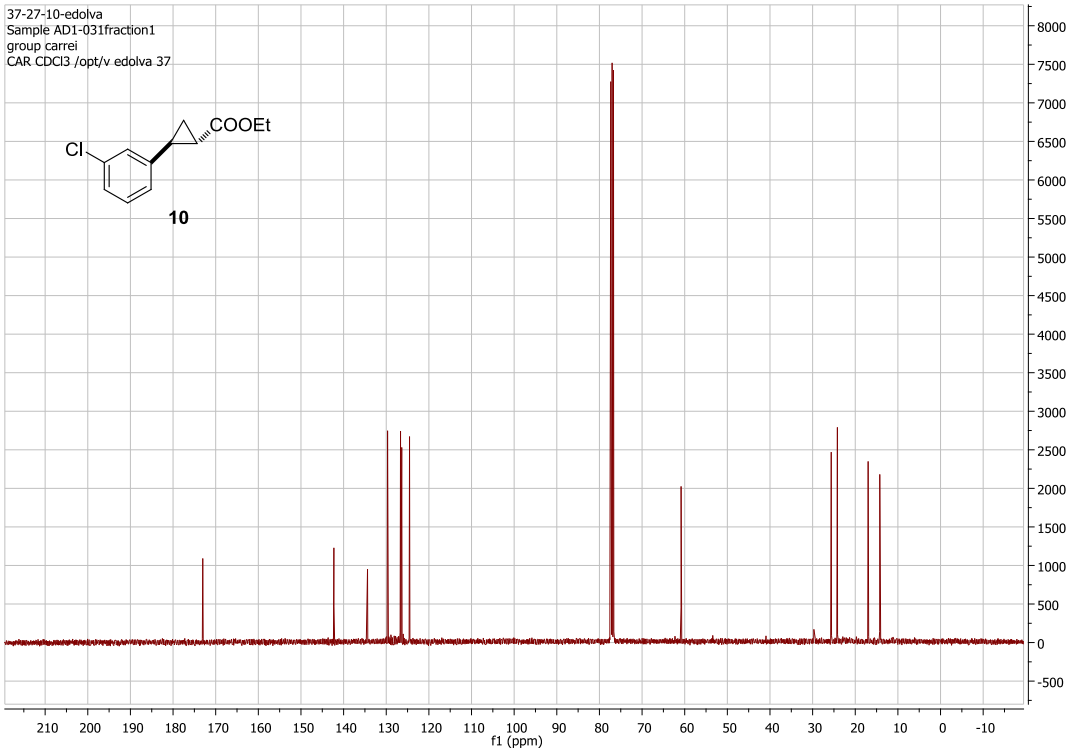

L05_CC_1H
STANDARD 1H OBSERVE
COOEt
8
f1 (ppm)

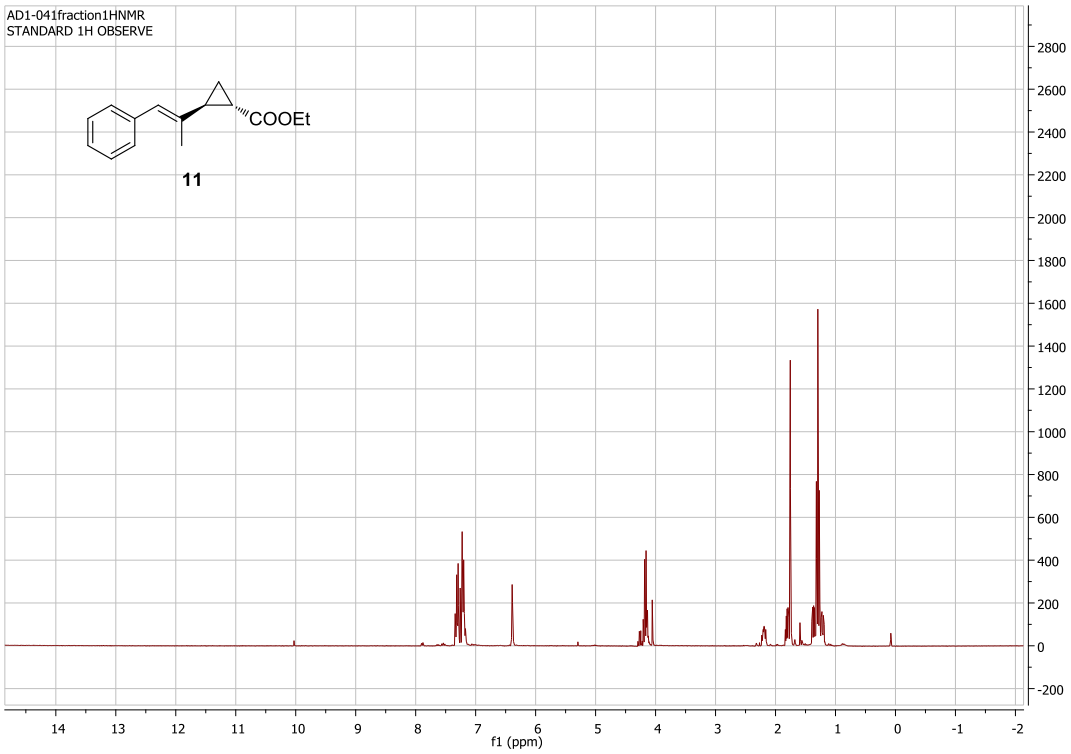

26-25-11-emoran
Sample L05_CC
group carrei
CAR CDCl3 /opt/v emoran 26
COOEt
8
f1 (ppm)

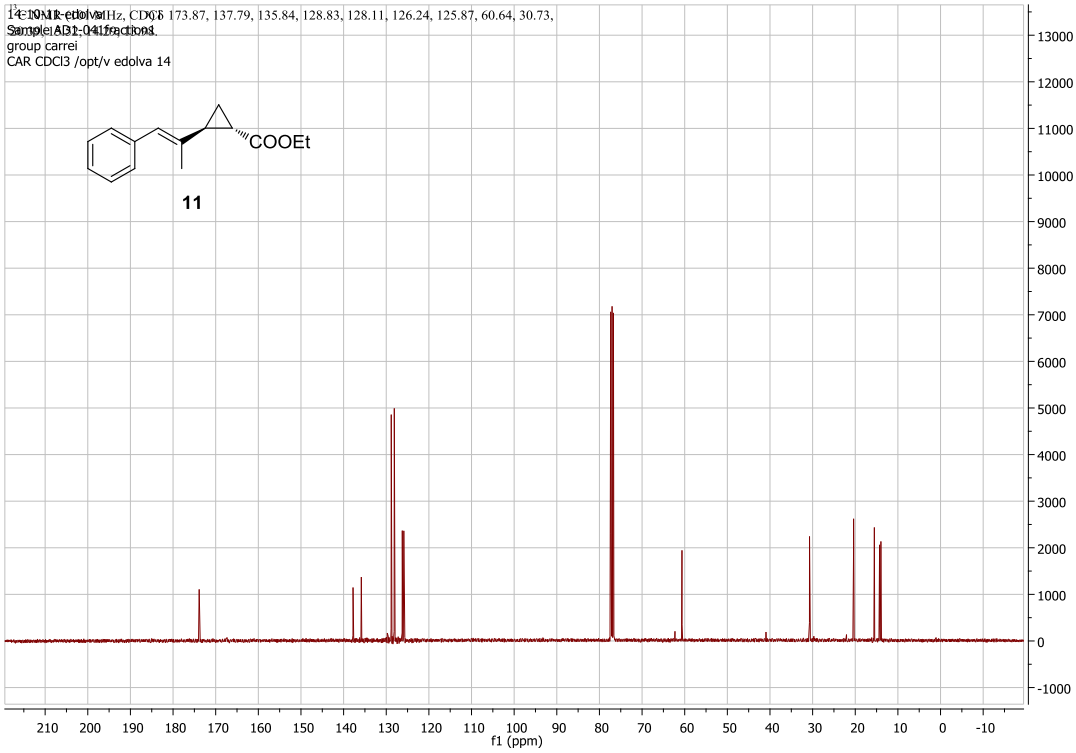

L-08_CC_1H
STANDARD 1H OBSERVE
O2N
COOEt
9
f1 (ppm)


13-29-11-emoran
Sample L-08_CC
group carrei
CAR CDCl3 /opt/v emoran 13
O2N
COOEt
9
f1 (ppm)


AD1-031fraction1HNMR
STANDARD 1H OBSERVE
Cl
COOEt
10
f1 (ppm)


37-27-10-edolva
Sample AD1-031fraction1
group carrei
CAR CDCl3 /opt/v edolva 37
Cl
COOEt
10
f1 (ppm)


AD1-041fraction1HNMR
STANDARD 1H OBSERVE
COOEt
11
f1 (ppm)


group carrei
CAR CDCl3 /opt/v edolva 14
COOEt
11
f1 (ppm)