Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

for

Retro-Claisen benzylation: direct use of benzyl alcohols in Pd-catalyzed couplings with nitriles

Tapan Maji, Kinthada Ramakumar and Jon A. Tunge*

Department of Chemistry, The University of Kansas, 1251 wescoe Hall Drive, Lawrence, Kansas 66045-7528, United States

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General Information:

All reactions were run in flame-dried glassware under argon atmosphere using standard Schlenk techniques or in an inert atmosphere glove box and in sealed microwave vials. Commercially available reagents and solvents were used without additional purification unless otherwise stated. Few benzyl alcohols were prepared from the corresponding ketone by well known $NaBH_4$ reduction. Compound purification was effected by flash chromatography using 230x400 mesh, 60 Å porosity, silica. ^1H NMR spectra and ^{13}C NMR spectra were obtained on a Bruker Avance 400 and a Bruker Avance 500 DRX spectrometer respectively unless otherwise mentioned and referenced to residual protio solvent signals (most spectra were taken using a QNP Cryoprobe). Structural assignments are based on ^1H, ^{13}C, DEPT-135, COSY, HSQC and IR spectroscopies. Mass Spectrometry was run using EI or ESI techniques.

General procedure for benzylation:

A flame-dried 10 mL microwave vial was charged with NaH (11.5 mg, 0.48 mmol, 2.2 equivalents, 95% NaH), $Pd(PPh_3)_4$ (12.6 mg, 0.01 mmol, 5 mol%) in a glove box. This vial was capped and removed from the glove box. Freshly distilled THF (1 mL) was added to the reaction mixture and stirred. 4-Methoxybenzyl alcohol, **2a** (36.15 mg, 0.26 mmol) was added to the reaction vessel with a syringe and the syringe was rinsed two times with the inside reaction mixture to ensure the full transfer of the alcohol (in case of solid benzyl alcohol derivatives, it was added inside the glove box along with the addition of NaH and $Pd(PPh_3)_4$ and capped and removed from glove box and then the solvent THF was added as described above). The reaction mixture was stirred for five minutes and then cyanoester **1a** (50 mg, 0.218 mmol) was added to the reaction vessel with a syringe and washed two times with the inside solvent mixture. The vial was submerged in an oil bath at 95 °C for 24 h and then cooled down to room temperature. The minor pressure buildup inside the vial was carefully released by piercing the septum with a syringe needle before uncapped. The resulting solution was then quenched with water (3 mL) and extracted with ethyl acetate (3x10 mL). The combined organic part was dried over Na_2SO_4 and concentrated in rotary evaporator. The crude was then subjected to silica gel column chromatography to obtain pure benzylated product.

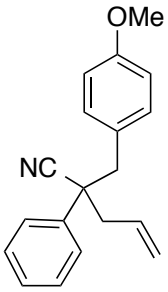
General procedure for one-pot, 3-component coupling:

A flame-dried 10 mL microwave vial was charged with NaH (20.9 mg, 0.873 mmol, 3.3 equivalents, 95% NaH), $Pd(PPh_3)_4$ (15.27 mg, 0.013 mmol, 5 mol%) in a glove box. This vial was capped and removed from the glove box. Freshly distilled THF (1 mL) was added to the reaction mixture and stirred. Ethyl phenylcyanoacetate (50 mg, 0.264 mmol) followed by allyl acetate (29.1 mg, 0.291 mmol) were added to the reaction vessel with syringes and washed each syringe two times with the inside solvent mixture to ensure the full transfer of the starting materials. After five minutes stirring at room temperature, 4-methoxybenzyl alcohol, **2a** (43.8 mg, 0.317 mmol) was added to the same reaction vessel with another syringe and the syringe was rinsed two times like before to ensure the full transfer of the alcohol (in case of solid benzyl alcohols, it was added inside the glove box along with the addition of NaH and $Pd(PPh_3)_4$ and capped and removed from glove box and then the solvent THF was added as described above). The vial was submerged in an oil bath at 95 °C for 24 h and then cooled down to room temperature. The minor pressure buildup inside the vial was carefully released by piercing the septum with a syringe needle before uncapped. The resulting solution was then quenched with water (3 mL) and extracted with ethyl acetate (3x10 mL). The combined organic part was dried over Na_2SO_4 and concentrated in rotary evaporator. The crude was then subjected to silica gel column chromatography to obtain pure benzylated product.

Note: Liquid benzyl alcohol derivatives were stored on molecular sieves powder (4 Å) in sealed microwave vial prior use for the benzylation reactions to avoid the formation of protonated product.

Spectroscopic data for the benzylated compounds:

2-(4-methoxybenzyl)-2-phenylpent-4-enenitrile (3a)



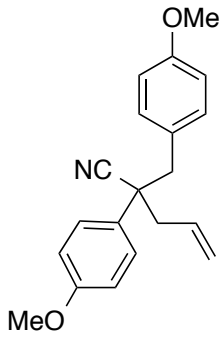
Colorless oil, yield 78%. 1H NMR (400 MHz, $CDCl_3$): δ 7.45-7.25 (m, 5H), 6.90 (d, *J* = 12 Hz, 2H), 6.75 (d, *J* = 8 Hz, 2H), 5.85-5.60 (m, 1H), 5.30-5.10 (m, 2H), 3.78 (s, 3H), 3.20 (d, *J* = 13.6 Hz, 1H), 3.11 (d, *J* = 13.6, 1H), 2.90-2.70 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 159.01, 137.69, 132.08, 131.60, 128.90, 128.05, 127.07, 126.82, 121.87, 120.33, 113.66, 55.37, 49.78, 46.41, 43.63.

IR (neat): ν_{max} 2243, 1612, 1514, 1247, 1033, 831, 698 cm^{-1}.

HRMS calcd. for $C_{19}H_{19}NO$ [M + H] 278.1545; found 278.1557.

2-(4-methoxybenzyl)-2-(4-methoxyphenyl)pent-4-enenitrile (3b)



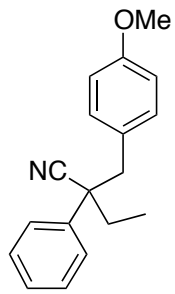
White solid, yield 62%. 1H NMR (400 MHz, $CDCl_3$): δ 7.23 (d, *J* = 8.8 Hz, 2H), 6.89 (tt, *J* = 6.6, 2.3 Hz, 4H), 6.74 (d, *J* = 8.4 Hz, 2H), 5.82-5.59 (m, 1H), 5.31-5.04 (m, 2H), 3.83 (s, 3H), 3.78 (s, 3H), 3.17 (d, *J* = 13.2 Hz, 1H), 3.06 (d, *J* = 13.6 Hz, 1H), 2.89-2.57(m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 158.97, 158.75, 132.02, 131.41, 129.40, 127.76, 126.98, 121.90, 119.99, 113.93, 113.43, 55.29, 55.16, 48.83, 46.30, 43.51.

IR (neat): ν_{max} 2235, 1612, 1514, 1249, 1180, 1033, 835 cm^{-1}.

HRMS calcd. for $C_{20}H_{21}NO_2$ [M + Na] 330.1470; found 330.1476.

2-(4-methoxybenzyl)-2-phenylbutanenitrile (3c)



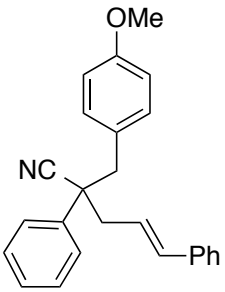
Gummy oil, yield 67%. 1H NMR (500 MHz, $CDCl_3$): δ 7.34-7.17 (m, 5H), 6.81 (d, *J* = 8.5 Hz, 2H), 6.64 (d, *J* = 8.5 Hz, 2H), 3.67 (s, 3H), 3.06 (d, *J* = 14.0 Hz, 1H), 2.99 (d, *J* = 13.5 Hz, 1H), 2.00 (qd, *J* = 7.3, 3.2 Hz, 2H), 0.86 (t, *J* = 7.4 Hz, 3H).

13C NMR (126 MHz, $CDCl_3$): δ 158.74, 137.65, 131.35, 128.70, 127.71, 127.17, 126.52, 122.01, 113.40, 55.16, 50.65, 46.86, 32.38, 9.73.

IR (neat): ν_{max} 2253, 1612, 1514, 1492, 1301, 1249, 1033, 833 cm^{-1}.

HRMS calcd. for $C_{18}H_{19}NO$ [M^+] 265.1467; found 265.1466.

(*E*)-2-(4-methoxybenzyl)-2,5-diphenylpent-4-enenitrile (3d)



Gummy oil, yield 68%. 1H NMR (400 MHz, $CDCl_3$): 7.44-7.20 (m, 10H), 6.92 (d, *J* = 8.4 Hz, 2H), 6.75 (d, *J* = 8.4 Hz, 2H), 6.51 (dd, *J* =

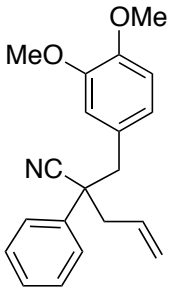
15.8, 1.4 Hz, 1H), 6.17-5.97 (m, 1H), 3.73 (s, 3H), 3.25 (d, *J* = 13.6 Hz, 1H), 3.15 (d, *J* = 14.0 Hz, 1H), 2.96 (dd, *J* = 7.9, 6.5 Hz, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 158.81, 137.54, 136.74, 134.94, 131.41, 128.75, 128.48, 127.90, 127.59, 126.88, 126.61, 126.36, 123.21, 121.71, 113.47, 55.16, 49.86, 46.12, 42.81.

IR (neat): ν_{max} 2244, 1604, 1514, 1248, 1020, 696 cm^{-1}.

HRMS calcd. for $C_{25}H_{23}NO$ [M + Na] 376.1677; found 376.1677.

2-(3,4-dimethoxybenzyl)-2-phenylpent-4-enenitrile (3e)



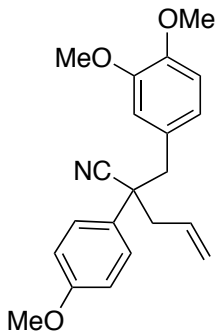
Yellow oil, yield 67%. 1H NMR (400 MHz, $CDCl_3$): δ 7.45-7.25 (m, 5H), 6.73 (d, *J* = 8 Hz, 1H), 6.62 (dd, *J* = 8.4, 2 Hz, 1H), 6.30 (d, *J* = 1.6 Hz, 1H), 5.83-5.65 (m, 1H), 5.25-5.15 (m, 2H), 3.85 (s, 3H), 3.64 (s, 3H), 3.21 (d, *J* = 13.6 Hz, 1H), 3.09 (d, *J* = 13.6 Hz, 1H), 2.93-2.73 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 148.11, 137.47, 131.85, 128.71, 127.82, 127.18, 126.73, 122.61, 121.68, 120.20, 113.23, 110.56, 55.73, 55.54, 49.61, 46.70, 43.44.

IR (neat): ν_{max} 2247, 1591, 1450, 1240, 1027, 860, 700 cm^{-1}.

HRMS calcd. for $C_{20}H_{21}NO_2$ [M + Na] 330.1470; found 330.1471.

2-(3,4-dimethoxybenzyl)-2-(4-methoxyphenyl)pent-4-enenitrile (3f)



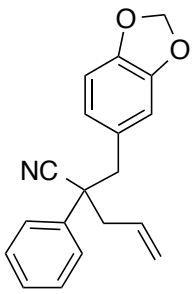
Gummy oil, yield 80%. 1H NMR (400 MHz, $CDCl_3$): δ 7.23 (dd, *J* = 8.7, 1.6 Hz, 2H), 6.88 (d, *J* = 8.8 Hz, 2H), 6.73 (dd, *J* = 8.2, 1.4 Hz, 1H), 6.61 (dd, *J* = 8.2, 2.0 Hz, 1H), 6.35 (d, *J* = 1.9 Hz, 1H), 5.84 - 5.63 (m, 1H), 5.27-5.11 (m, 2H), 3.85 (s, 3H), 3.81(s, 3H), 3.68 (s, 3H), 3.18 (d, *J* = 13.6 Hz, 1H), 3.05 (d, *J* = 13.6 Hz, 1H), 2.83-2.70 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 159.04, 148.10, 132.00, 129.39, 127.85, 127.33, 122.63, 121.94, 120.06, 113.94, 113.32, 110.56, 55.74, 55.58, 55.32, 48.85, 46.81, 43.49.

IR (neat): ν_{max} 2235, 1612, 1514, 1240, 1037, 853 cm^{-1}.

HRMS calcd. for $C_{21}H_{23}NO_3$ [M + Na] 360.1576; found 360.1574.

2-(benzo[*d*][1,3]dioxol-5-ylmethyl)-2-phenylpent-4-enenitrile (3g)



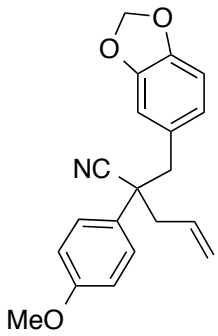
Gummy oil, yield 91%. 1H NMR (400 MHz, $CDCl_3$): δ 7.52-7.29 (m, 5H), 6.66 (dd, *J* = 7.9, 3.1 Hz, 1H), 6.47 (ddd, *J* = 8.8, 4.2, 2.3 Hz, 2H), 5.91 (s, 2H), 5.78-5.58 (m, 1H), 5.34-5.10 (m, 2H), 3.17 (d, *J* = 13.6 Hz, 1H), 3.08 (d, *J* = 13.6 Hz, 1H), 2.94-2.61 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 147.25, 146.80, 137.36, 131.77, 128.75, 128.43, 127.94, 126.56, 123.74, 121.53, 120.21, 110.57, 107.90, 100.93, 49.49, 46.69, 43.53.

IR (neat): ν_{max} 2247, 1614, 1502, 1488, 1249, 1039, 927, 700 cm^{-1}.

HRMS calcd. for $C_{19}H_{17}NO_2$ [M^+] 291.1259; found 291.1258.

2-(benzo[*d*][1,3]dioxol-5-ylmethyl)-2-(4-methoxyphenyl)pent-4-enenitrile (3h)



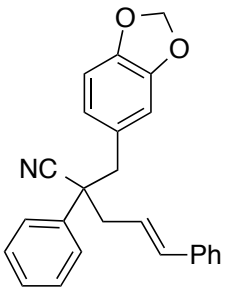
Gummy oil, yield 74%. 1H NMR (400 MHz, $CDCl_3$): δ 7.25 (d, *J* = 8.8 Hz, 2H), 6.89 (d, *J* = 8.8 Hz, 2H), 6.66 (d, *J* = 8.8 Hz, 1H), 6.55-6.38 (m, 2H), 5.92 (s, 2H), 5.70 (dddd, *J* = 16.8, 10.1, 7.5, 6.6 Hz, 1H), 5.28-5.06 (m, 2H), 3.83 (s, 3H), 3.14 (d, *J* = 13.6 Hz, 1H), 3.04 (d, *J* = 13.6 Hz, 1H), 2.76 (ddt, *J* = 7.4, 4.7, 1.2 Hz, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 159.03, 147.23, 146.76, 131.93, 129.29, 128.58, 127.70, 123.76, 121.78, 120.08, 114.01, 110.62, 107.90, 100.92, 55.30, 48.76, 46.77, 43.66.

IR (neat): ν_{max} 2233, 1610, 1514, 1490, 1444, 1251, 1037, 831, 736 cm^{-1}.

HRMS calcd. for $C_{20}H_{19}NO_3$ [M + H] 322.1443; found 322.1442.

(*E*)-2-(benzo[*d*][1,3]dioxol-5-ylmethyl)-2,5-diphenylpent-4-enenitrile (3i)



Gummy oil, yield 68%. 1H NMR (400 MHz, $CDCl_3$): δ 7.47-7.15 (m, 10H), 6.67 (d, *J* = 8.0 Hz, 1H), 6.58-6.39 (m, 3H), 6.15-6.01 (m,

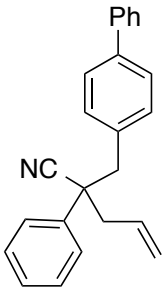
1H), 5.89 (s, 2H), 3.22 (d, *J* = 13.6, 1H), 3.13 (d, *J* = 13.6, 1H), 3.03-2.87 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 147.28, 146.83, 137.43, 136.71, 135.03, 128.82, 128.49, 128.01, 127.63, 126.56, 126.36, 123.76, 123.09, 121.59, 110.59, 107.93, 100.95, 49.80, 46.61, 42.93.

IR (neat): ν_{max} 2241, 1617, 1502, 1488, 1446, 1247, 1039, 813, 698 cm^{-1}.

HRMS calcd. for $C_{25}H_{21}NO_2$ [M^+] 367.1572; found 367.1573.

2-([1,1'-biphenyl]-4-ylmethyl)-2-phenylpent-4-enenitrile (3j)



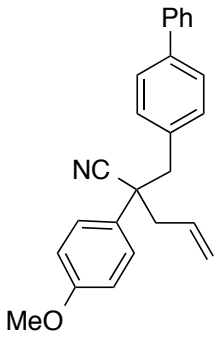
White solid, yield 71%. 1H NMR (400 MHz, $CDCl_3$): δ 7.57 (d, *J* = 7.6 Hz, 2H), 7.52-7.23 (m, 10H), 7.07 (dt, *J* = 8.2, 4.7 Hz, 2H), 5.73 (ddt, *J* = 16.9, 9.9, 7.2 Hz, 1H), 5.38-5.04 (m, 2H), 3.30 (d, *J* = 13.2 Hz, 1H), 3.20 (d, *J* = 13.6 Hz, 1H), 3.02-2.73 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 140.62, 140.07, 137.36, 133.85, 131.78, 130.78, 128.75, 127.94, 127.27, 126.99, 126.75, 126.62, 121.57, 120.27, 49.37, 46.60, 43.59.

IR (neat): ν_{max} 2245, 1612, 1488, 1448, 993, 846, 698 cm^{-1}.

HRMS calcd. for $C_{24}H_{21}N$ [M^+] 323.1674; found 323.1676.

2-([1,1'-biphenyl]-4-ylmethyl)-2-(4-methoxyphenyl)pent-4-enenitrile (3k)



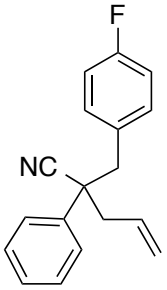
White solid, yield 71%. 1H NMR (400 MHz, $CDCl_3$): δ 7.58 (d, *J* = 7.2 Hz, 2H), 7.51-7.33 (m, 5H), 7.28-7.22 (m, 2H), 7.06 (d, *J* = 7.6 Hz, 2H), 6.90 (d, *J* = 8.8 Hz, 2H), 5.84-5.65 (m, 1H), 5.31-5.10 (m, 2H), 3.84 (s, 3H), 3.27 (d, *J* = 13.2 Hz, 1H), 3.16 (d, *J* = 13.6 Hz, 1H), 2.92-2.72 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 159.05, 140.64, 139.99, 133.98, 131.93, 130.81, 129.27, 128.74, 127.78, 127.26, 126.99, 126.72, 121.81, 120.15, 113.99, 55.30, 48.65, 46.71, 43.69.

IR (neat): ν_{max} 2251, 1610, 1512, 1253, 1033, 925, 831, 698 cm^{-1}.

HRMS calcd. for $C_{25}H_{23}NO$ [M^+] 353.1780; found 353.1797.

2-(4-fluorobenzyl)-2-phenylpent-4-enenitrile (3l)



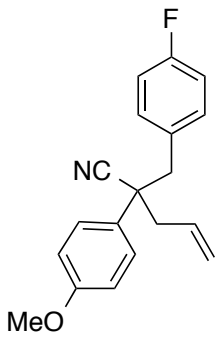
Yellow oil, yield 52%. 1H NMR (400 MHz, $CDCl_3$): δ 7.45 – 7.25 (m, 5H), 7.06-6.80 (m, 4H), 5.87-5.60 (m, 1H), 5.33-5.08 (m, 2H), 3.24 (d, *J* = 13.6 Hz, 1H), 3.11 (d, *J* = 14.0 Hz, 1H), 2.83 (qd, *J* = 14.1, 7.3 Hz, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 162.14 (d, *J* = 246.2 Hz), 137.05, 131.82 (d, *J* = 32.5 Hz), 131.65, 130.52 (d, *J* = 3.3 Hz), 128.78, 128.01, 126.54, 121.37, 120.35, 114.95 (d, *J* = 21.1 Hz), 49.47, 46.07, 43.64.

IR (neat): ν_{max} 2237, 1600, 1510, 1448, 1222, 991, 925, 837, 698 cm^{-1}.

HRMS calcd. for $C_{18}H_{16}FN$ [M + H] 266.1345; found 266.1362.

2-(4-fluorobenzyl)-2-(4-methoxyphenyl)pent-4-enenitrile (3m)



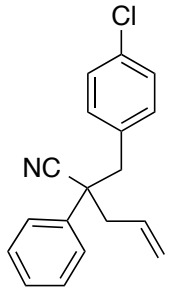
Yellow oil, yield 58%. 1H NMR (400 MHz, $CDCl_3$): δ 7.22 (ddt, *J* = 6.5, 4.7, 2.6 Hz, 2H), 6.91 (dddt, *J* = 10.7, 8.9, 6.5, 2.0 Hz, 6H), 5.72 (dddd, *J* = 14.1, 9.9, 7.3, 5.5 Hz, 1H), 5.32-5.06 (m, 2H), 3.83 (s, 3H), 3.21 (d, *J* = 13.6 Hz, 1H), 3.07 (d, *J* = 13.6 Hz, 1H), 2.79 (tdd, *J* = 13.6, 10.7, 7.3 Hz, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 162.12 (d, *J* = 247.1 Hz), 159.08, 131.89, 131.81 (d, *J* = 2.1 Hz), 130.67 (d, *J* = 3.3 Hz), 128.95, 127.70, 121.62, 120.22, 114.92 (d, *J* = 21.4 Hz), 114.02, 55.30, 48.75, 46.18, 43.74.

IR (neat): ν_{max} 2243, 1608, 1512, 1253, 1033, 835, 767 cm^{-1}.

HRMS calcd. for $C_{19}H_{18}FNO$ [M + Na] 318.1270; found 318.1275.

2-(4-chlorobenzyl)-2-phenylpent-4-enenitrile (3n)



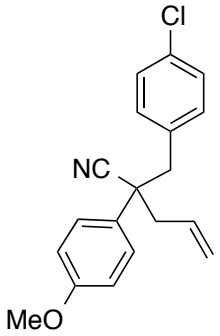
Gummy oil, yield 68%. 1H NMR (400 MHz, $CDCl_3$): δ 7.55-7.25 (m, 5H), 7.16 (d, *J* = 8.4 Hz, 2H), 6.88 (d, *J* = 8.0 Hz, 2H), 5.78-5.64 (m, 1H), 5.37-5.03 (m, 2H), 3.24 (d, *J* = 13.2 Hz, 1H), 3.11 (d, *J* = 13.6 Hz, 1H), 2.93-2.73 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 136.93, 133.33, 133.25, 131.59, 131.57, 128.81, 128.24, 128.06, 126.53, 121.27, 120.43, 49.33, 46.16, 43.72.

IR (neat): ν_{max} 2255, 1608, 1492, 1448, 1093, 925, 727, 698 cm^{-1}.

HRMS calcd. for $C_{18}H_{16}ClN$ [M + H] 282.1050; found 282.1050.

2-(4-chlorobenzyl)-2-(4-methoxyphenyl)pent-4-enenitrile (3o)



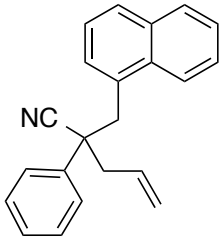
Gummy oil, yield 62%. 1H NMR (500 MHz, $CDCl_3$): δ 7.17-7.02 (m, 4H), 6.88-6.67 (m, 4H), 5.75-5.50 (m, 1H), 5.20-4.98 (m, 2H), 3.74 (s, 3H), 3.20 (d, *J* = 13.2 Hz, 1H), 3.06 (d, *J* = 13.6 Hz, 1H), 2.69 (qdt, *J* = 14.1, 7.7, 1.2 Hz, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 159.11, 133.40, 133.26, 131.73, 131.63, 128.82, 128.22, 127.69, 121.52, 120.30, 114.05, 55.30, 48.62, 46.28, 43.83.

IR (neat): ν_{max} 2231, 1610, 1514, 1253, 1186, 1033, 831, 744 cm^{-1}.

HRMS calcd. for $C_{19}H_{18}ClNO$ [M + Na] 334.0975; found 334.0989.

2-(naphthalen-1-ylmethyl)-2-phenylpent-4-enenitrile (3p)



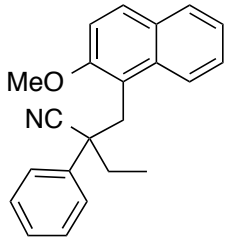
Gummy oil, yield 61%. 1H NMR (400 MHz, $CDCl_3$): δ 7.84 (d, *J* = 8.0 Hz, 2H), 7.78 (d, *J* = 8.4 Hz, 1H), 7.51-7.20 (m, 9H), 5.83-5.65 (m, 1H), 5.27-5.12 (m, 2H), 3.84 (d, *J* = 14.4 Hz, 1H), 3.58 (d, *J* = 14.4 Hz, 1H), 3.05-2.74 (m, 2H).

13C NMR (126 MHz, $CDCl_3$) δ 137.78, 133.69, 132.61, 131.91, 131.00, 129.06, 128.75, 128.69, 128.19, 127.94, 126.61, 125.79, 125.46, 125.01, 123.66, 121.80, 120.34, 49.20, 43.38, 42.60.

IR (neat): ν_{max} 2249, 1596, 1510, 925, 800, 781, 698 cm^{-1}.

HRMS calcd. for $C_{22}H_{19}N$ [M + Na] 320.1415; found 320.1427.

2-((2-methoxynaphthalen-1-yl)methyl)-2-phenylbutanenitrile (3q)



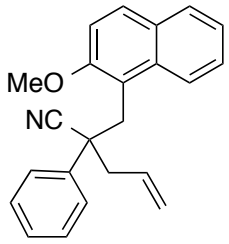
Yellow oil, yield 90%. 1H NMR (400 MHz, $CDCl_3$): δ 7.82 (d, *J* = 9.2 Hz, 1H), 7.77 (d, *J* = 7.2 Hz, 1H), 7.67 (d, *J* = 8.4 Hz, 1H), 7.42 (d, *J* = 6.4 Hz, 2H), 7.49-7.23 (m, 6H), 3.86 (s, 3H), 3.81 (d, *J* = 13.6 Hz, 1H), 3.66 (d, *J* = 13.6 Hz, 1H), 2.41-2.10 (m, 2H), 0.94 (t, *J* = 7.2 Hz, 3H).

13C NMR (126 MHz, $CDCl_3$): δ 155.73, 139.11, 133.74, 129.45, 128.89, 128.54, 128.33, 127.49, 126.51, 126.03, 123.63, 123.07, 122.51, 116.92, 112.42, 55.74, 50.07, 36.60, 31.96, 9.96.

IR (neat): ν_{max} 2233, 1623, 1596, 1514, 1265, 1253, 1026, 808, 700 cm^{-1}.

HRMS calcd. for $C_{22}H_{21}NO$ [M + Na] 338.1521; found 338.1513.

2-((2-methoxynaphthalen-1-yl)methyl)-2-phenylpent-4-enenitrile (3r)



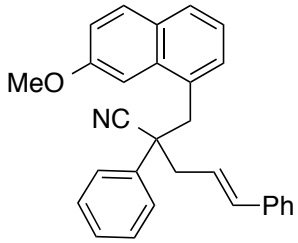
Yellow oil, yield 88%. 1H NMR (400 MHz, $CDCl_3$): δ 7.82 (d, *J* = 8.8 Hz, 1H), 7.77 (d, *J* = 7.6 Hz, 1H), 7.67 (d, *J* = 8.4 Hz, 1H), 7.45 - 7.38 (m, 2H), 7.37 - 7.24 (m, 6H), 5.80 - 5.64 (m, 1H), 5.24 - 5.06 (m, 2H), 3.86 (d, *J* = 14 Hz, 1H), 3.85 (s, 3H), 3.68 (d, *J* = 14 Hz, 1H), 3.10 - 3.00 (m, 1H), 2.95 - 2.83 (m, 1H).

13C NMR (126 MHz, $CDCl_3$): δ 155.72, 138.89, 133.70, 132.52, 129.60, 128.90, 128.50, 128.35, 127.61, 126.63, 126.11, 123.56, 123.14, 122.20, 119.78, 116.56, 112.37, 55.73, 48.99, 42.99, 36.22.

IR (neat): ν_{max} 2246, 1623, 1596, 1514, 1448, 1265, 1253, 1093, 923, 810, 698 cm^{-1}.

HRMS calcd. for $C_{23}H_{21}NO$ [M + Na] 350.1521; found 350.1509.

(*E*)-2-((7-methoxynaphthalen-1-yl)methyl)-2,5-diphenylpent-4-enenitrile (3s)



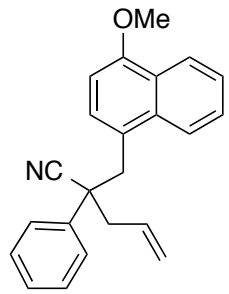
Gummy oil, yield 61%. 1H NMR (500 MHz) δ 7.73 (d, *J* = 9.0 Hz, 1H), 7.70-7.63 (m, 1H), 7.57 (dt, *J* = 8.6, 1.1 Hz, 1H), 7.40-7.32 (m, 2H), 7.28-7.04 (m, 11H), 6.38 (dt, *J* = 15.8, 1.4 Hz, 1H), 5.98 (ddd, *J* = 15.8, 7.8, 6.7 Hz, 1H), 3.81 (d, *J* = 14.0 Hz, 1H), 3.75 (s, 3H), 3.61 (d, *J* = 14.0 Hz, 1H), 3.24-2.68 (m, 2H).

13C NMR (126 MHz, $CDCl_3$) δ 155.74, 139.04, 136.96, 134.64, 133.71, 129.62, 128.93, 128.58, 128.41, 128.36, 127.67, 127.41, 126.61, 126.31, 126.14, 124.01, 123.59, 123.16, 122.21, 116.65, 112.40, 55.78, 49.29, 42.36, 36.18.

IR (neat): ν_{max} 2232, 1623, 1596, 1514, 1448, 1265, 1253, 1091, 966, 810, 696 cm^{-1}.

HRMS calcd. for $C_{29}H_{25}NO$ [M + Na] 426.1834; found 426.1840.

2-((4-methoxynaphthalen-1-yl)methyl)-2-phenylpent-4-enenitrile (3t)



Gummy oil, yield 65%. 1H NMR (400 MHz,) δ 8.29 (d, *J* = 7.6 Hz, 1H), 7.73 (d, *J* = 8.4 Hz, 1H), 7.50 - 7.15 (m, 7H), 7.20 (d, *J* = 8.0 Hz, 1H), 6.74 (dd, *J* = 7.9, 1.9 Hz, 1H), 5.73 (m, 1H), 5.27 - 5.07

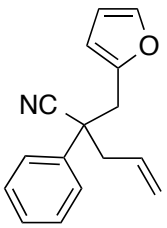
(m, 2H), 4.01 (s, 3H), 3.75 (d, *J* = 14.4 Hz, 1H), 3.51 (d, *J* = 14.4, Hz, 1H), 3.06 - 2.90 (m, 1H), 2.85 – 2.75 (m, 1H).

13C NMR (126 MHz, $CDCl_3$) δ 155.04, 137.95, 133.42, 132.04, 129.16, 128.71, 127.85, 126.63, 126.23, 125.60, 124.74, 123.47, 122.92, 122.40, 121.99, 120.18, 103.11, 55.45, 49.51, 43.16, 42.40.

IR (neat): ν_{max} 2243, 1585, 1510, 1463, 1448, 1271, 1226, 1026, 761, 700 cm^{-1}.

HRMS calcd. for $C_{23}H_{21}NO$ [M + Na] 350.1521; found 350.1522.

2-(furan-2-ylmethyl)-2-phenylpent-4-enenitrile (3u)



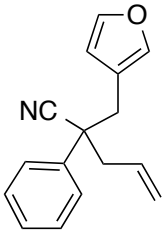
Gummy oil, yield 68%. 1H NMR (400 MHz) δ 7.48 - 7.23 (m, 6H), 6.27 (dt, *J* = 3.1, 1.4 Hz, 1H), 6.06 (d, *J* = 3.2 Hz, 1H), 5.79 - 5.60 (m, 1H), 5.29 - 5.11 (m, 2H), 3.33 (d, *J* = 15.2 Hz, 1H), 3.26 (d, *J* = 15.2 Hz, 1H) 2.88 - 2.70 (m, 2H).

13C NMR (126 MHz, $CDCl_3$) δ 149.45, 142.04, 137.40, 131.53, 128.77, 128.00, 126.24, 121.56, 120.41, 110.45, 109.11, 48.01, 43.46, 38.90.

IR (neat): ν_{max} 2242, 1586, 1498, 1023, 744, 698 cm^{-1}.

HRMS calcd. for $C_{16}H_{15}NO$ [M^+] 237.1154; found 237.1151.

2-(furan-3-ylmethyl)-2-phenylpent-4-enenitrile (3v)



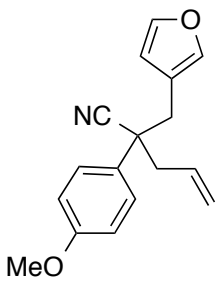
Gummy oil, yield 52%. 1H NMR (400 MHz) δ 7.48-7.21 (m, 6H), 7.12 (s, 1H), 6.02 (s, 1H), 5.77-5.65 (m, 1H), 5.28 -5.09 (m, 2H), 3.14 (d, *J* = 14.4 Hz, 1H), 3.04 (d, *J* = 14.4 Hz, 1H), 2.83-2.72 (m, 2H).

13C NMR (126 MHz, $CDCl_3$) δ 142.58, 141.24, 137.56, 131.68, 128.79, 127.99, 126.41, 121.81, 120.28, 118.42, 111.65, 48.70, 43.93, 36.22.

IR (neat): ν_{max} 2233, 1610, 1500, 1448, 1024, 927, 873, 698 cm^{-1}.

HRMS calcd. for $C_{16}H_{15}NO$ [M + H] 238.1232; found 238.1227.

2-(furan-3-ylmethyl)-2-(4-methoxyphenyl)pent-4-enenitrile (3w)



Gummy oil, yield 54%. 1H NMR (400 MHz) δ 7.34 - 7.24 (m, 3H), 7.12 (t, *J* = 2.2 Hz, 1H), 6.92 (tt, *J* = 6.6, 1.3 Hz, 2H), 6.02 (s, 1H),

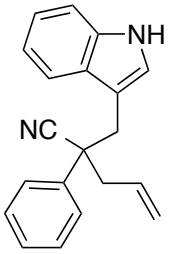
5.84 - 5.61 (m, 1H), 5.28 - 5.08 (m, 2H), 3.84 (s, 3H), 3.10 (d, *J* = 14.4 Hz, 1H), 2.99 (d, *J* = 14.4 Hz, 1H) 2.84-2.68 (m, 2H).

13C NMR (126 MHz, $CDCl_3$) δ 159.09, 142.55, 141.22, 131.84, 129.48, 127.57, 122.06, 120.16, 118.51, 114.03, 111.72, 55.30, 47.95, 44.00, 36.31.

IR (neat): ν_{max} 2241, 1611, 1514, 1253, 1029, 927, 831 cm^{-1}.

HRMS calcd. for $C_{17}H_{17}NO_2$ [M^+] 267.1259; found 267.1262.

2-((1*H*-indol-3-yl)methyl)-2-phenylpent-4-enenitrile (3x)



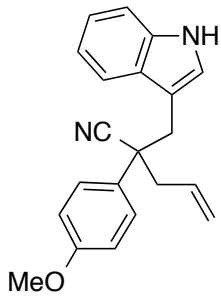
Yellow oil, yield 71%. 1H NMR (400 MHz, $CDCl_3$): δ 8.10 (s, 1H), 7.53 - 7.27 (m, 7H), 7.18 (t, *J* = 7.6 Hz, 1H), 7.07 (dd, *J* = 8.2, 6.7 Hz, 1H), 6.96 (d, *J* = 2.6 Hz, 1H), 5.72 (ddt, *J* = 17.2, 10.0, 7.0 Hz, 1H), 5.28 - 5.02 (m, 2H), 3.49 (d, *J* = 14.8, 1H), 3.37 (d, *J* = 14.4, 1H), 2.98 - 2.70 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 138.24, 135.57, 132.10, 128.75, 127.96, 127.83, 126.57, 124.10, 122.50, 121.97, 120.01, 119.57, 118.62, 111.16, 109.58, 49.78, 43.34, 37.01.

IR (neat): ν_{max} 3413, 2231, 1492, 1448,1340, 1097, 993, 925, 742, 698 cm^{-1}.

HRMS calcd. for $C_{20}H_{18}N_2$ [M + Na] 309.1368; found 309.1367.

2-((1*H*-indol-3-yl)methyl)-2-(4-methoxyphenyl)pent-4-enenitrile (3y)



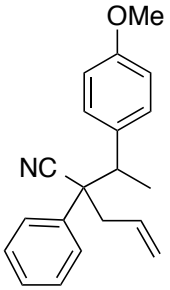
Yellow oil, yield 62%. 1H NMR (400 MHz, $CDCl_3$): δ 8.07 (s, 1H), 7.44 - 7.32 (m, 4H), 7.17 (t, *J* = 7.2 Hz, 1H), 7.07 (t, *J* = 7.2 Hz, 1H), 6.94 (s, 1H), 6.88 (d, *J* = 8.8 Hz, 2H), 5.72 (ddt, *J* = 17.1, 10.1, 7.2 Hz, 1H), 5.25 - 5.00 (m, 2H), 3.83 (s, 3H), 3.45 (d, *J* = 14.8 Hz, 1H), 3.33 (d, *J* = 14.8 Hz, 1H), 2.94 - 2.72 (m, 2H).

13C NMR (126 MHz, $CDCl_3$): δ 159.04, 135.54, 132.23, 130.23, 127.99, 127.70, 124.04, 122.70, 121.97, 119.87, 119.58, 118.67, 114.01, 111.03, 109.73, 77.29, 55.33, 48.95, 43.43, 37.05.

IR (neat): ν_{max} 3434, 2233, 1612, 1510, 1252, 1021, 748 cm^{-1}.

HRMS calcd. for $C_{21}H_{20}N_2O$ [M + Na] 339.1473; found 339.1471.

2-(1-(4-methoxyphenyl)ethyl)-2-phenylpent-4-enenitrile (3A)



Gummy oil, combined yield 52% (dr = 72:28). Major diastereomer: 1H NMR (500 MHz, $CDCl_3$): δ 7.23 - 7.10 (m, 3H), 7.10-6.95 (m, 2H), 6.77 -6.65 (m, 2H), 6.64 - 6.49 (m, 2H), 5.50 (dddd, *J* = 16.7, 10.1, 7.6, 6.4 Hz, 1H), 5.15 - 4.96 (m, 2H), 3.66 (s, 3H), 3.13 (q, *J* = 7.1 Hz, 1H), 2.83 (ddt, *J* = 14.2, 7.6, 1.1 Hz, 1H), 2.72 (ddt, *J* = 14.2, 6.4, 1.3 Hz, 1H), 1.46 (d, *J* = 7.0 Hz, 3H).

13C NMR (126 MHz, $CDCl_3$): δ 158.50, 135.89, 132.25, 129.85, 128.78, 128.10, 127.56, 121.69, 119.75, 113.02, 55.13, 53.59, 48.02, 41.71, 17.59.

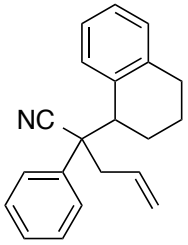
Minor diastereomer: 1H NMR (500 MHz, $CDCl_3$): δ 7.43-7.23 (m, 7H), 6.88-6.77 (m, 2H), 5.35-5.21 (m, 1H), 4.90-4.77 (m, 2H), 3.75 (s, 3H), 3.05 (q, *J* = 7.1 Hz, 1H), 2.83 (ddt, *J* = 14.2, 6.4, 1.3 Hz, 1H), 2.28 (ddt, *J* = 14.2, 7.5, 1.2 Hz, 1H), 1.12 (d, *J* = 7.1 Hz, 3H).

13C NMR (126 MHz, $CDCl_3$): δ 159.04, 137.69, 132.84, 132.07, 129.75, 127.76, 126.69, 120.91, 119.41, 113.82, 55.28, 54.17, 48.59, 43.10, 17.59.

IR (neat): ν_{max} 2241, 1610, 1514, 1494, 1448, 1249, 1180, 1033, 831, 740 cm^{-1}.

HRMS calcd. for $C_{20}H_{21}NO$ [M + Na] 314.1510; found 314.1510.

2-phenyl-2-(1,2,3,4-tetrahydronaphthalen-1-yl)pent-4-enenitrile (3B)



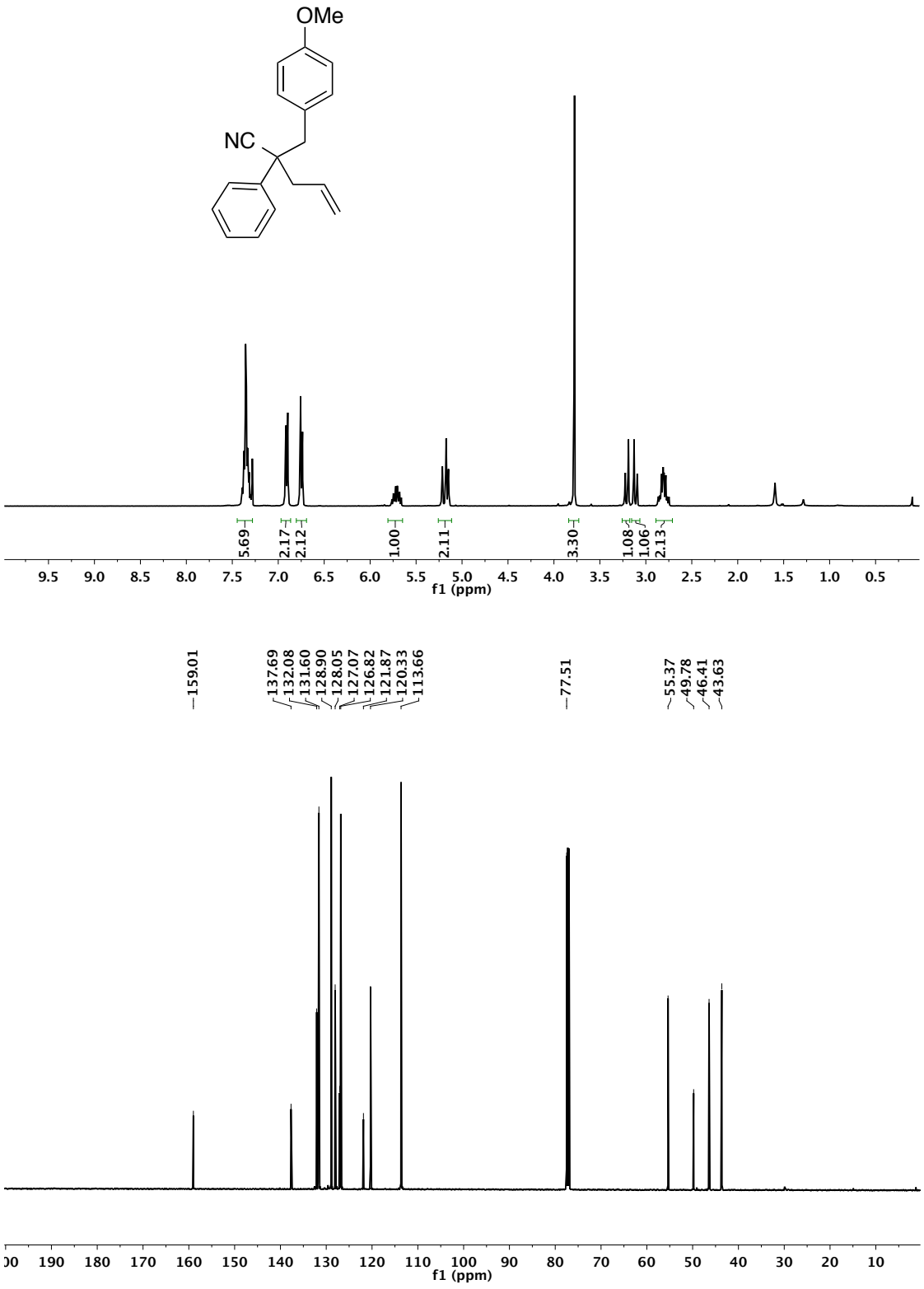
White solid, yield 54%. Major isomer: 1H NMR (500 MHz, $CDCl_3$): δ 7.42 - 7.29 (m, 3H), 7.21 - 7.12 (m, 3H), 7.07 (d, *J* = 7.6 Hz, 1H), 6.91 (td, *J* = 7.6, 1.5 Hz, 1H), 6.49 (dd, *J* = 7.9, 1.3 Hz, 1H), 5.53 (ddt, *J* = 17.0, 10.1, 6.9 Hz, 1H), 5.17 (ddd, *J* = 17.0, 2.0, 1.1 Hz, 1H), 5.08 (dd, *J* = 10.1, 1.6 Hz, 1H), 3.48 (dd, *J* = 6.8, 4.9 Hz, 1H), 3.08 - 2.84 (m, 2H), 2.63 (dt, *J* = 16.4, 6.7 Hz, 1H), 2.45 (dt, *J* = 16.4, 6.3 Hz, 1H), 2.28 - 2.15 (m, 1H), 2.09 (dddd, *J* = 14.0, 8.9, 6.8, 4.6 Hz, 1H), 2.03 - 1.91 (m, 1H), 1.68 - 1.52 (m, 1H).

13C NMR (126 MHz, $CDCl_3$): δ 140.08, 137.30, 134.18, 132.24, 130.11, 129.09, 128.40, 127.78, 127.72, 127.02, 124.67, 121.92, 119.78, 53.43, 46.71, 42.03, 28.85, 26.00, 20.09.

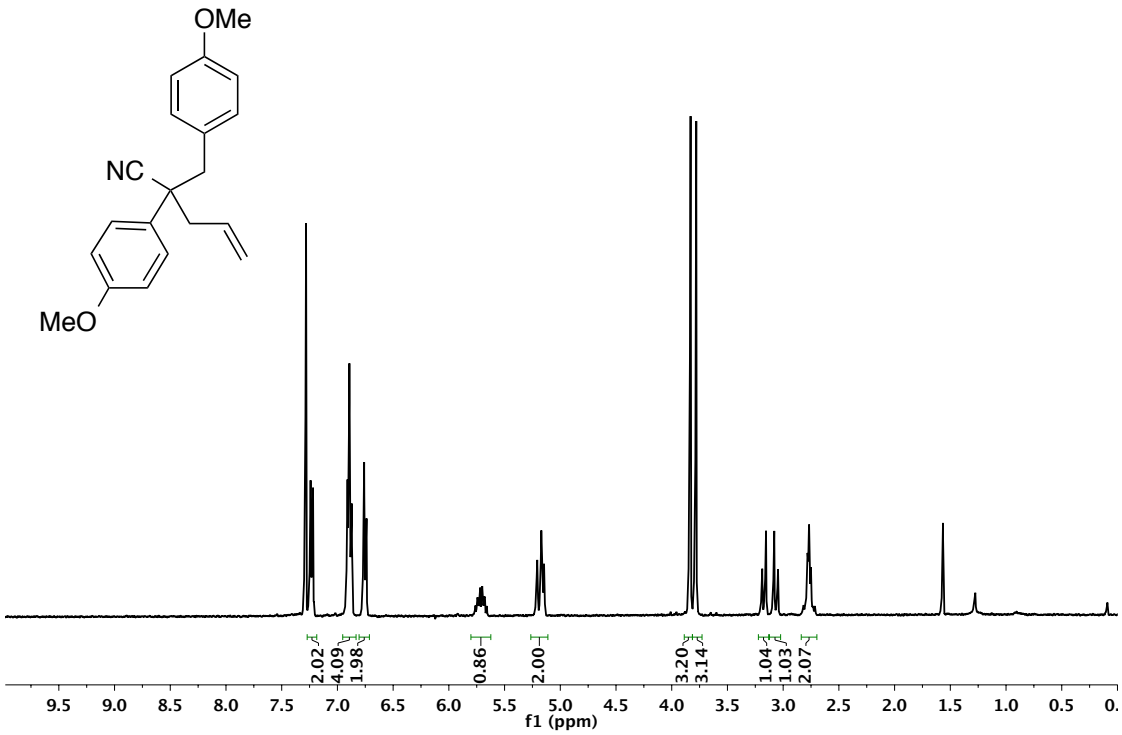
IR (neat): ν_{max} 2243, 1730, 1492, 1448, 1371, 1238, 1062, 1029, 923, 765, 700 cm^{-1}.

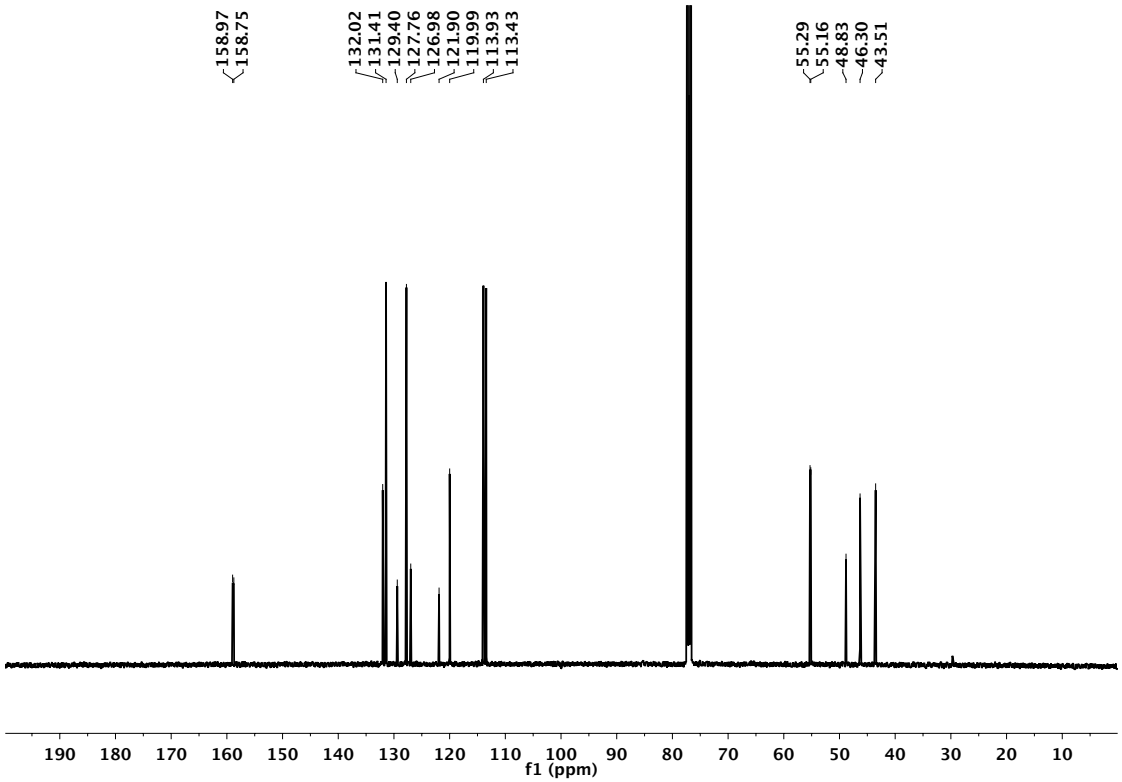
HRMS calcd. for $C_{21}H_{21}N$ [M + NH_4] 305.2018; found 305.2024.

2-(4-methoxybenzyl)-2-phenylpent-4-enenitrile (**3a**)

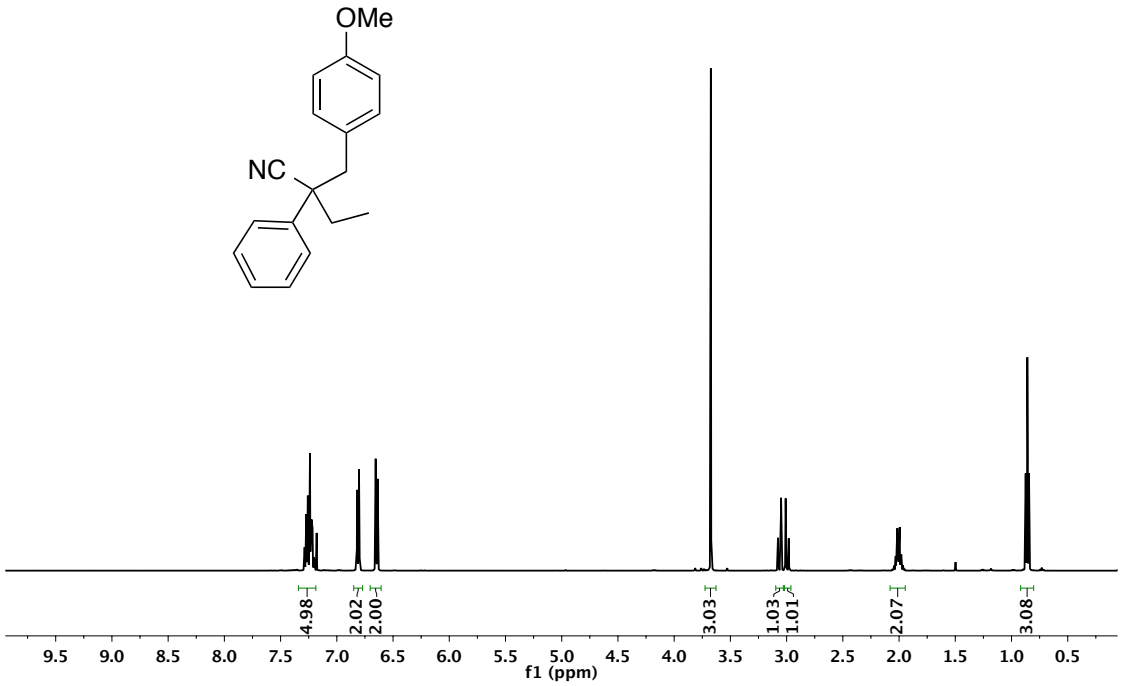


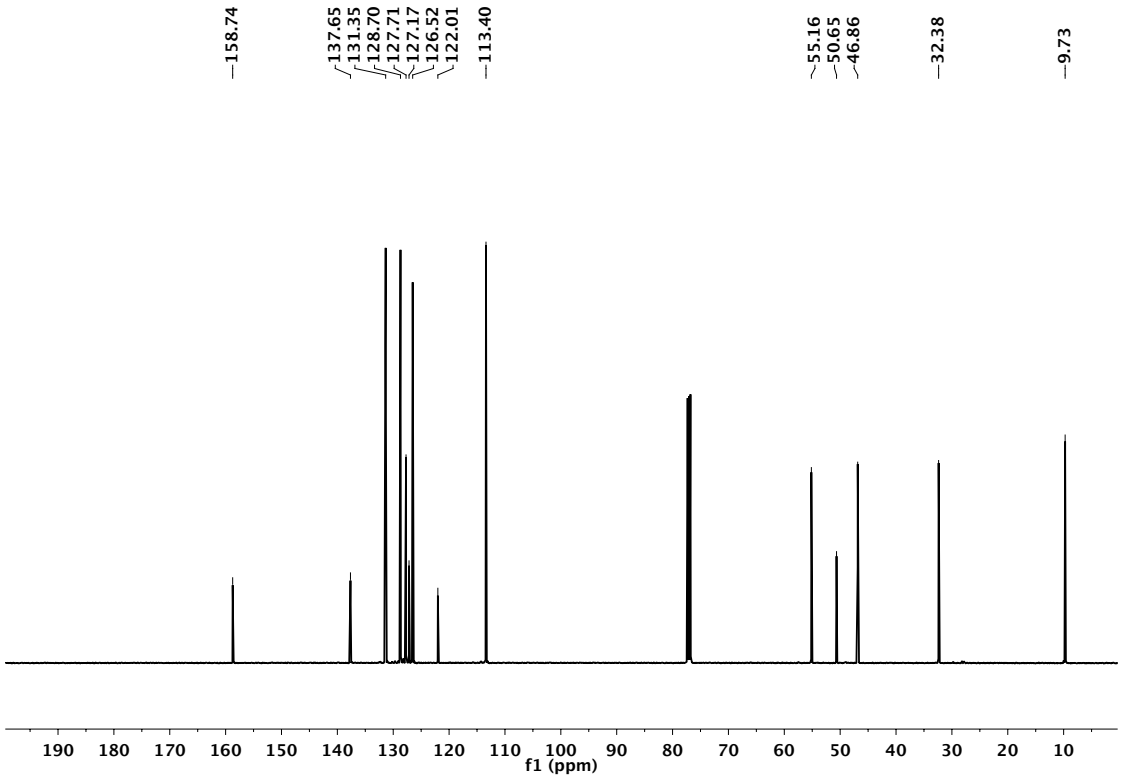
2-(4-methoxybenzyl)-2-(4-methoxyphenyl)pent-4-enenitrile (**3b**)



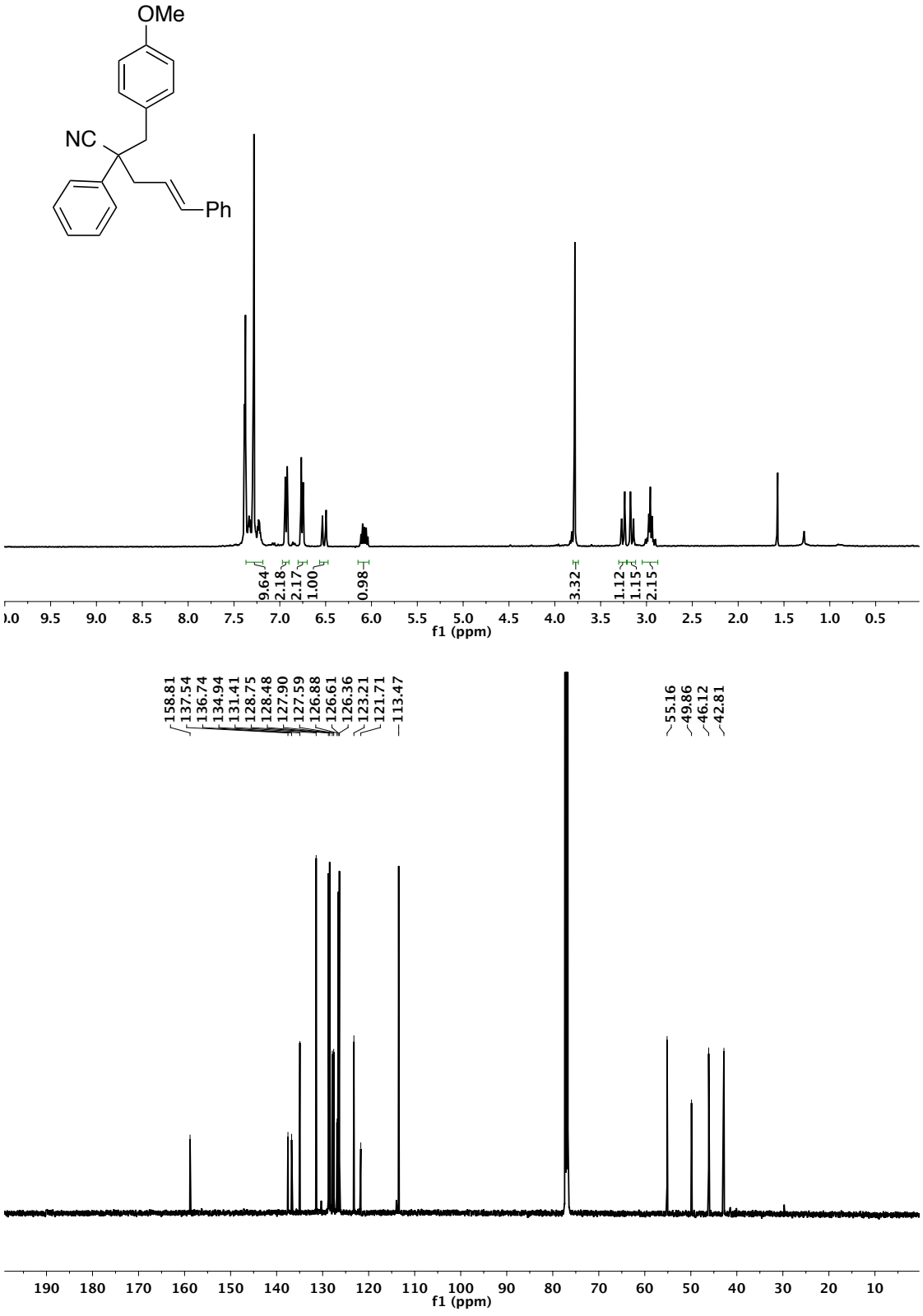


2-(4-methoxybenzyl)-2-phenylbutanenitrile (**3c**)

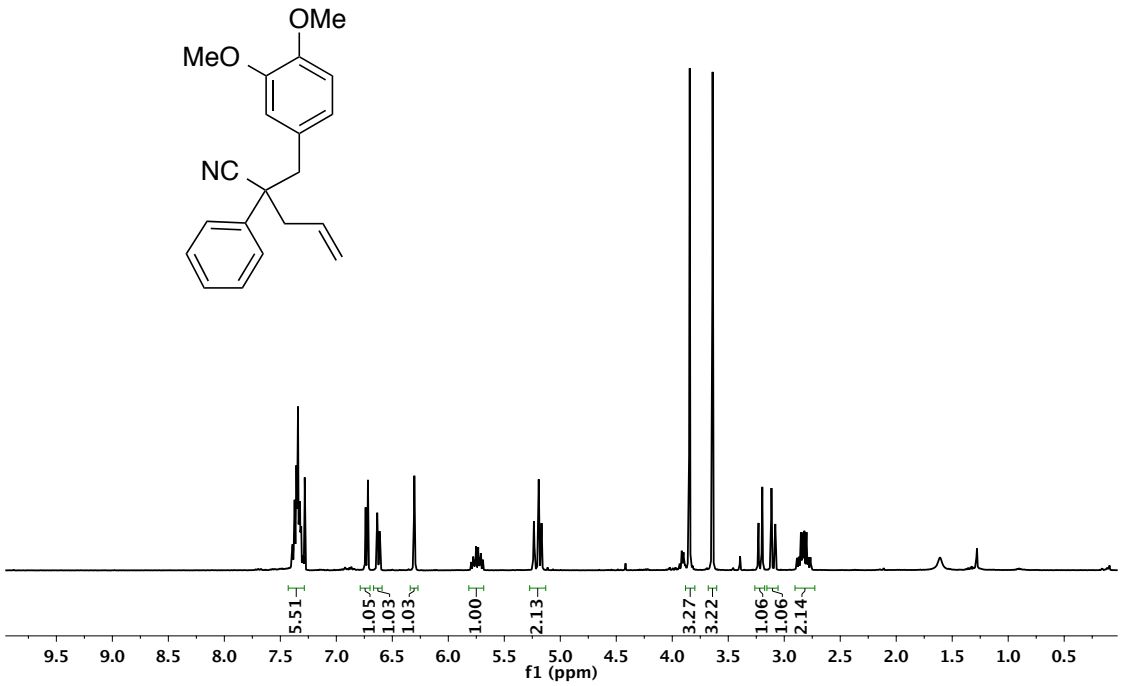


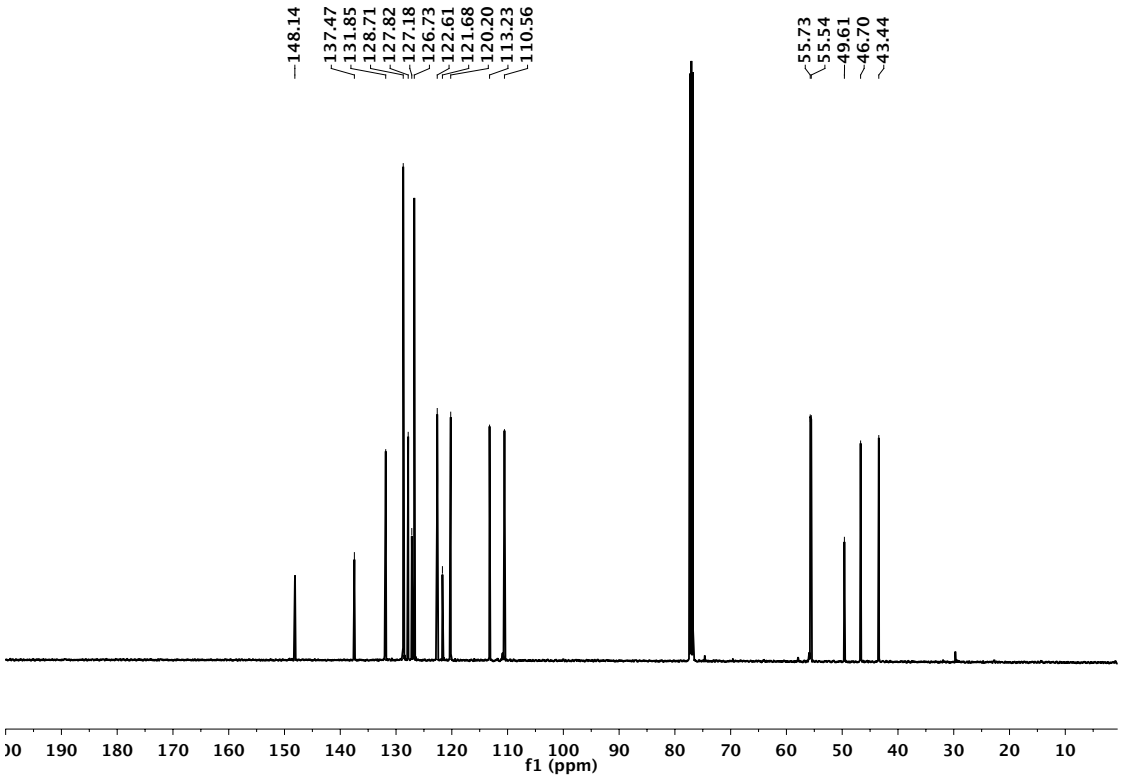


(*E*)-2-(4-methoxybenzyl)-2,5-diphenylpent-4-enenitrile (**3d**)

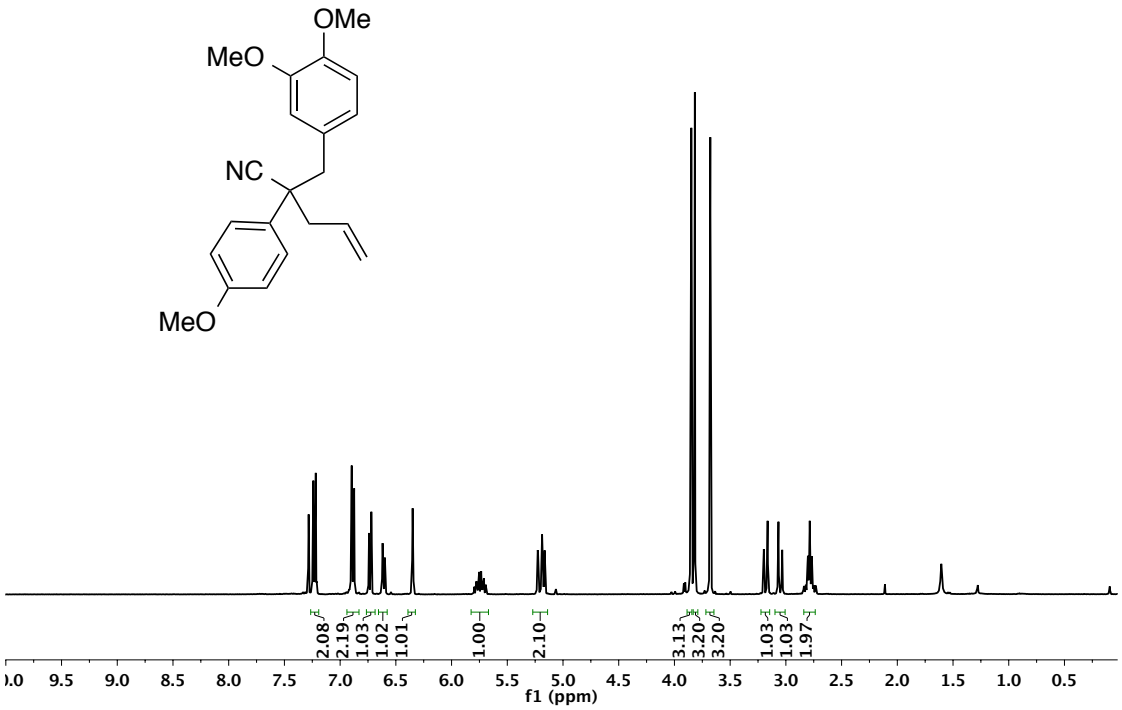


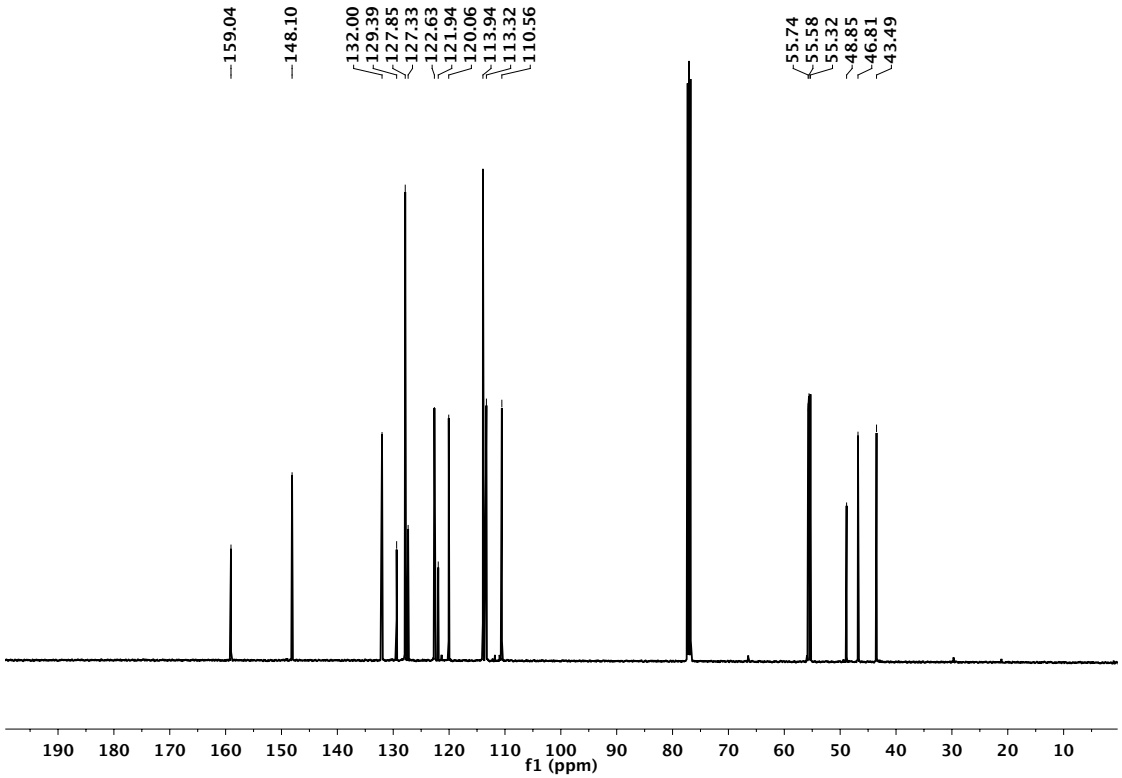
2-(3,4-dimethoxybenzyl)-2-phenylpent-4-enenitrile (**3e**)



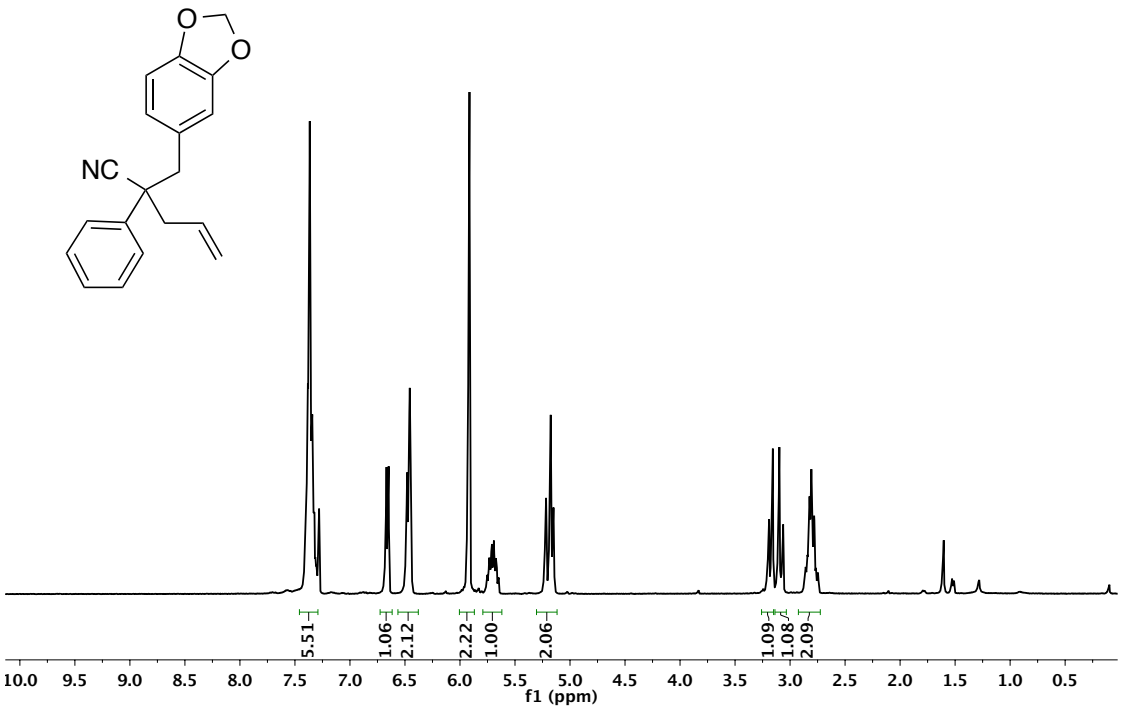


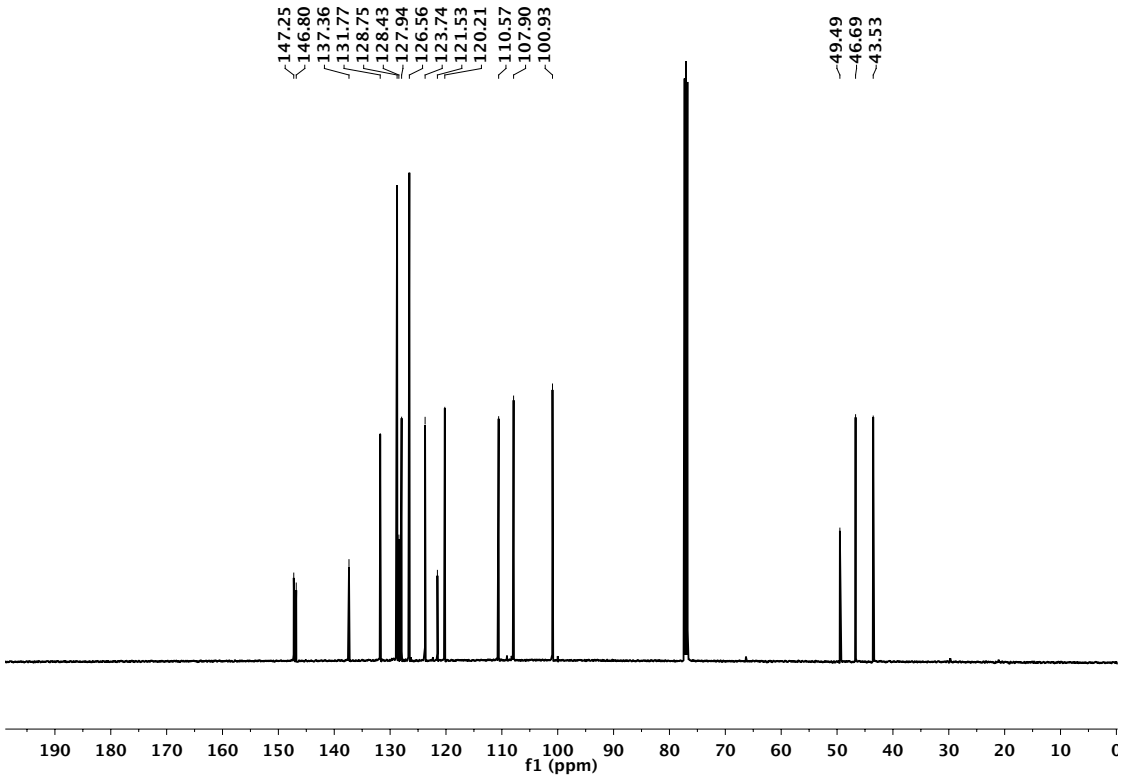
2-(3,4-dimethoxybenzyl)-2-(4-methoxyphenyl)pent-4-enenitrile (**3f**)



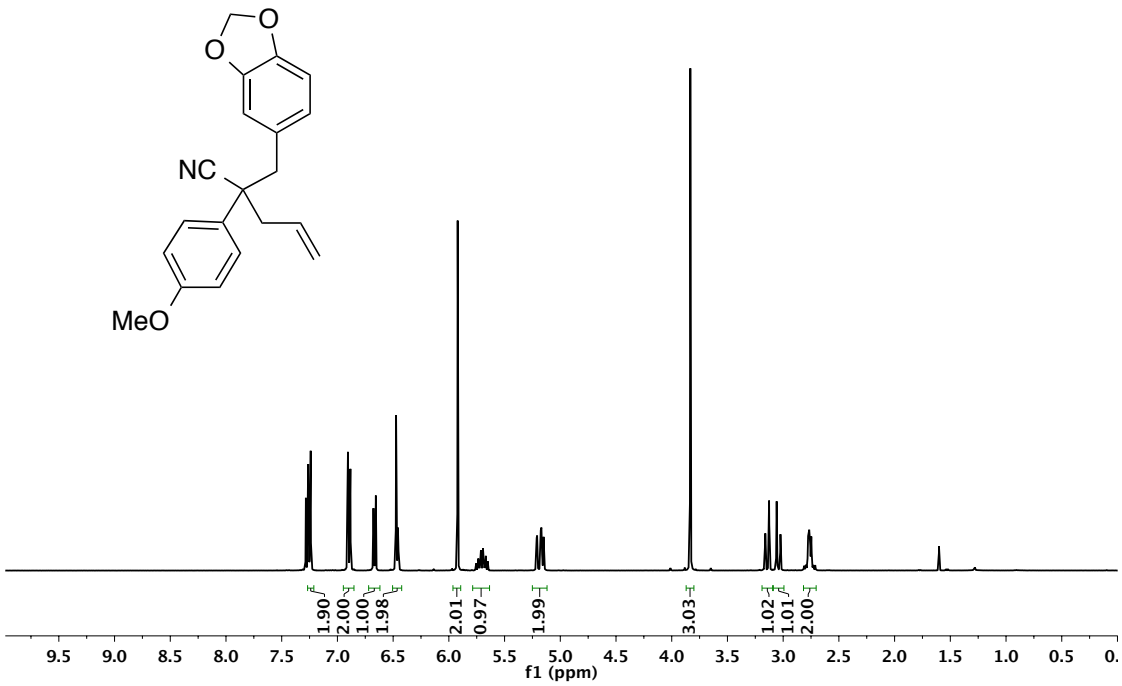


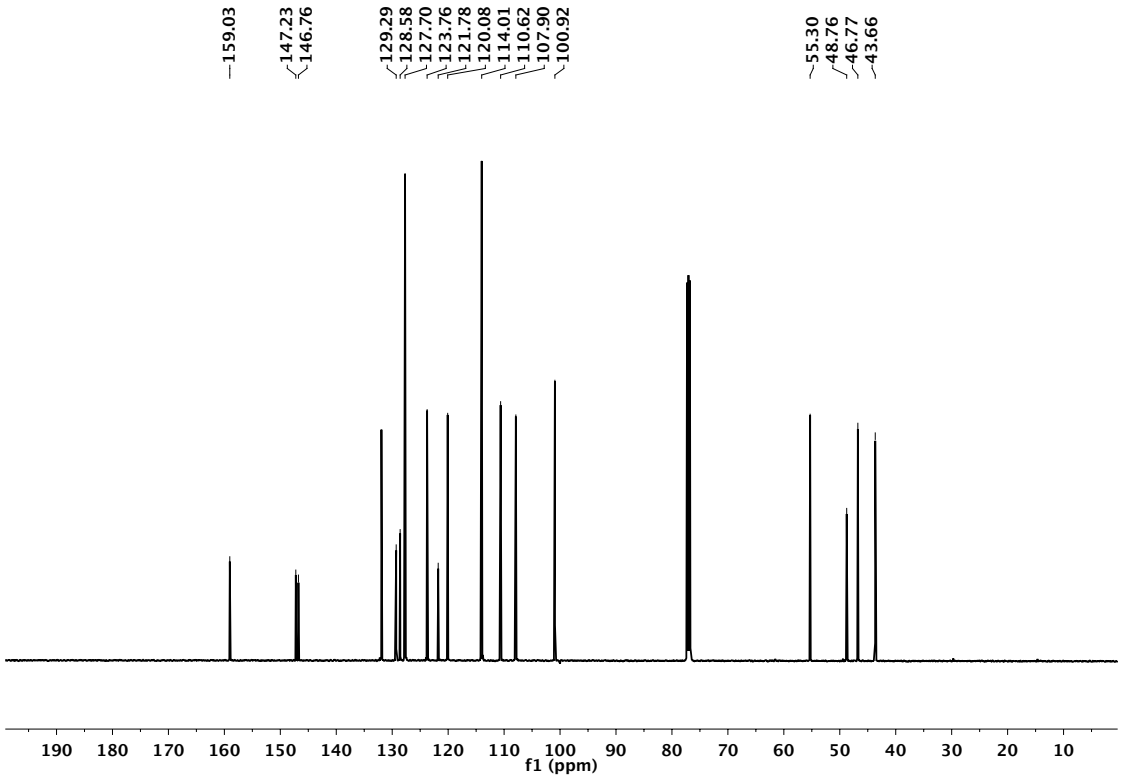
2-(benzo[*d*][1,3]dioxol-5-ylmethyl)-2-phenylpent-4-enenitrile (**3g**)



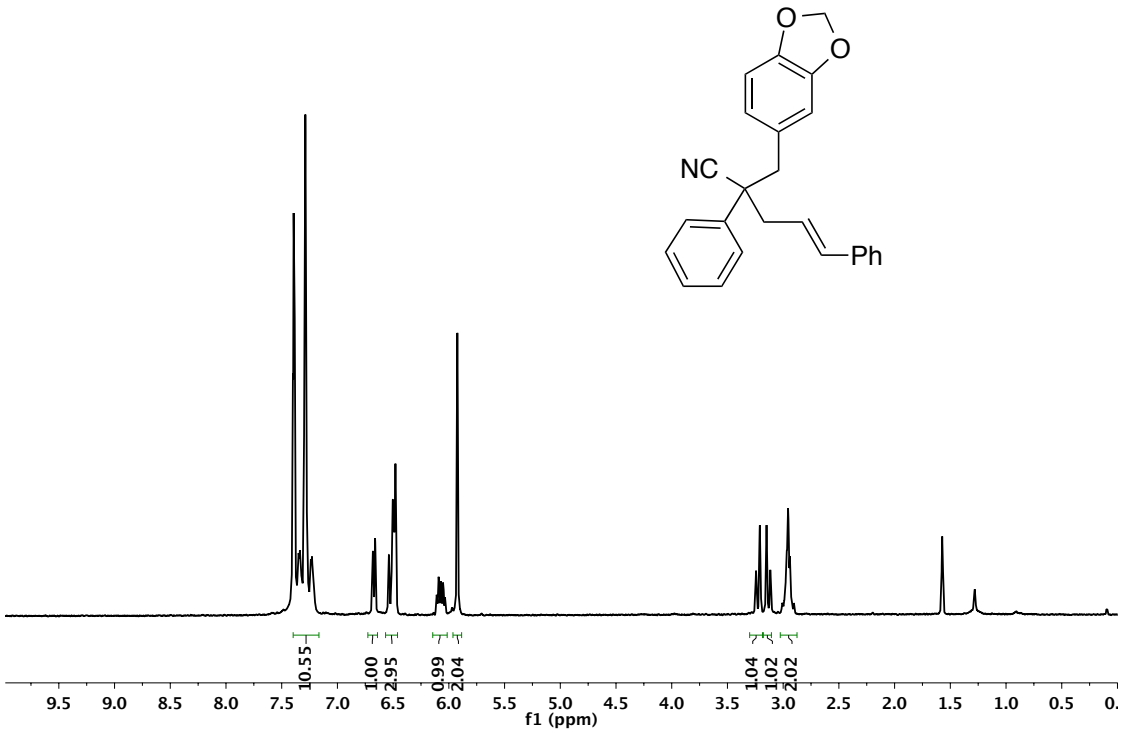


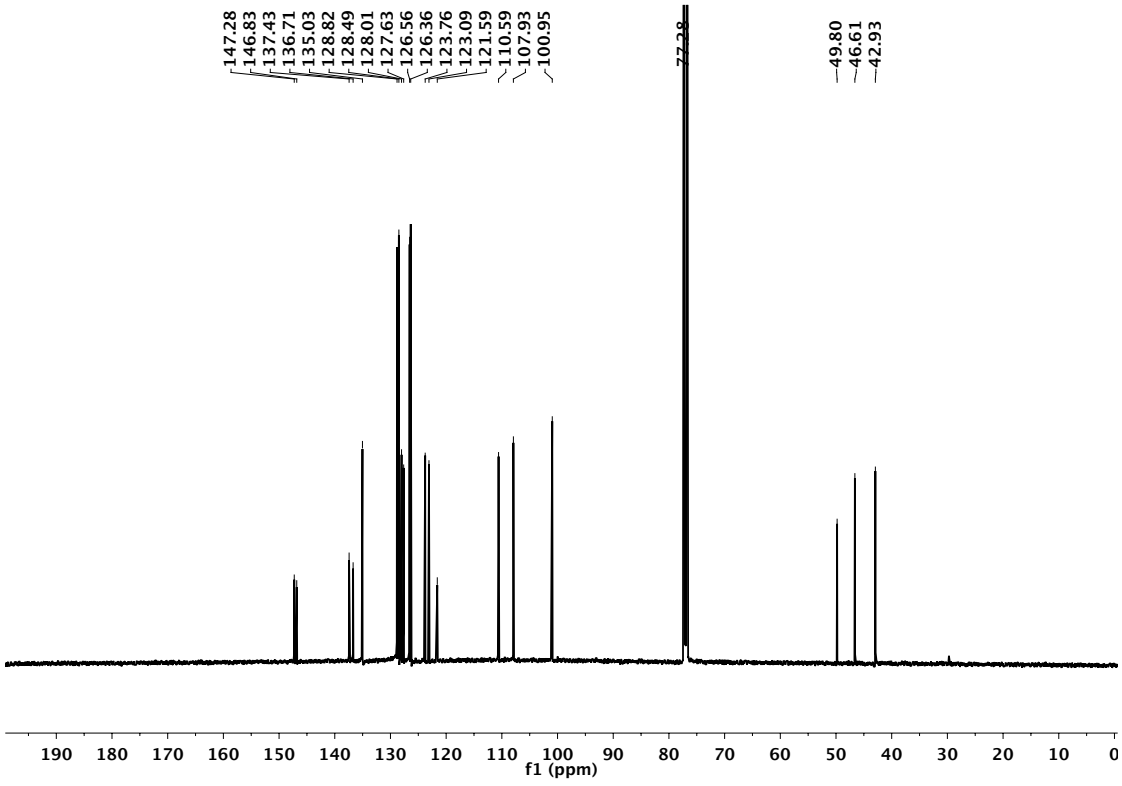
2-(benzo[*d*][1,3]dioxol-5-ylmethyl)-2-(4-methoxyphenyl)pent-4-enenitrile (**3h**)



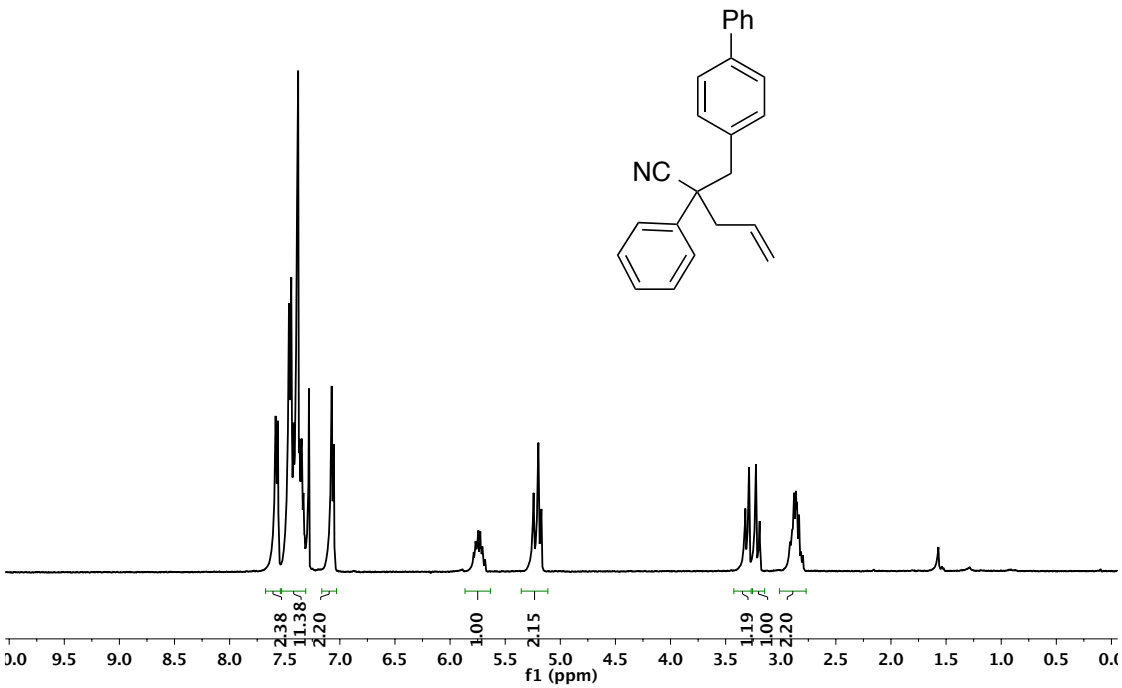


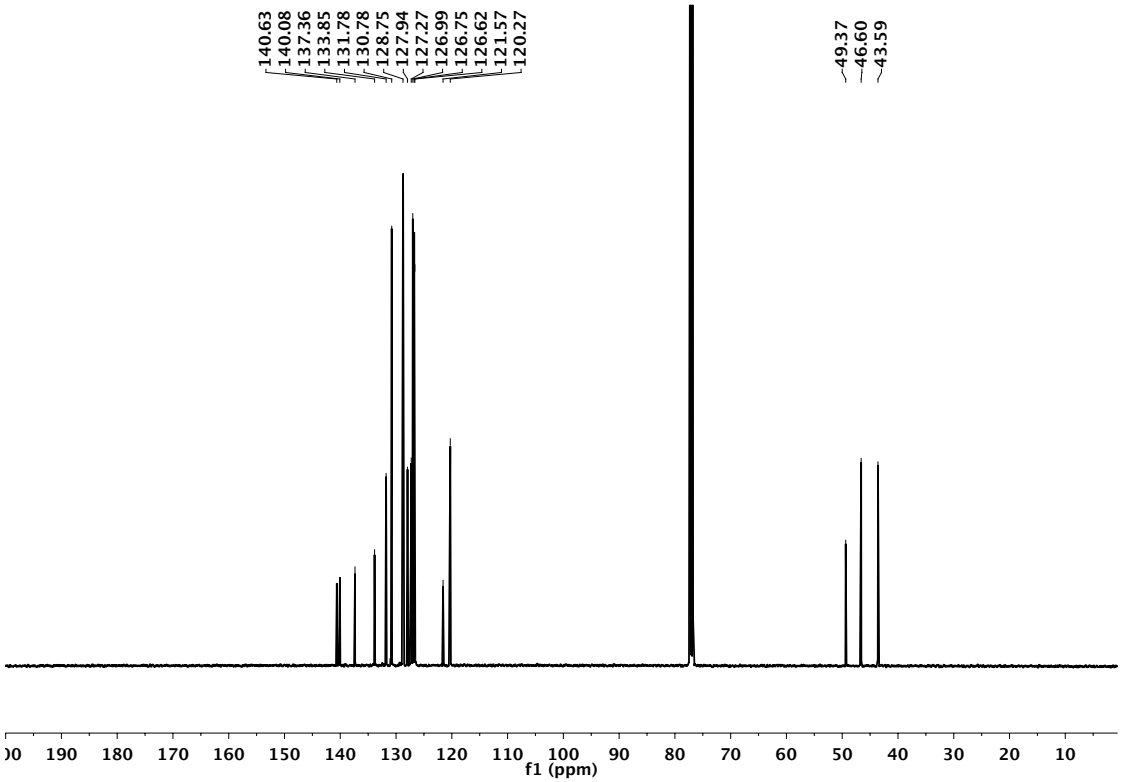
(*E*)-2-(benzo[*d*][1,3]dioxol-5-ylmethyl)-2,5-diphenylpent-4-enenitrile (**3i**)



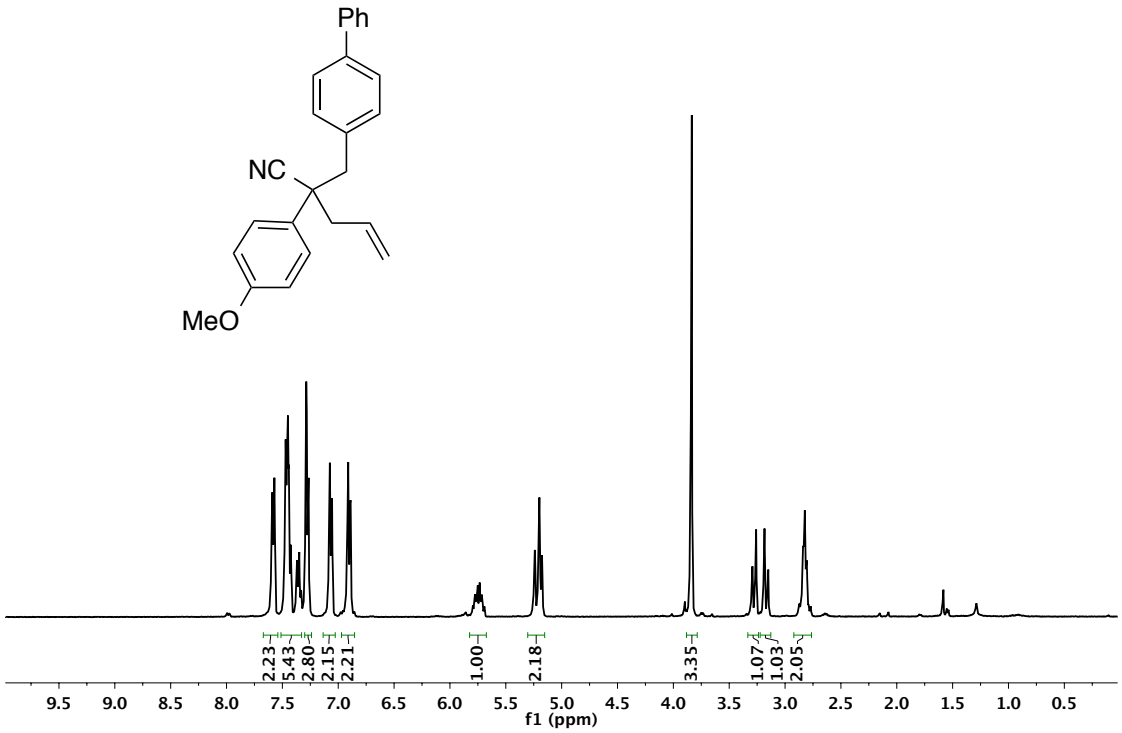


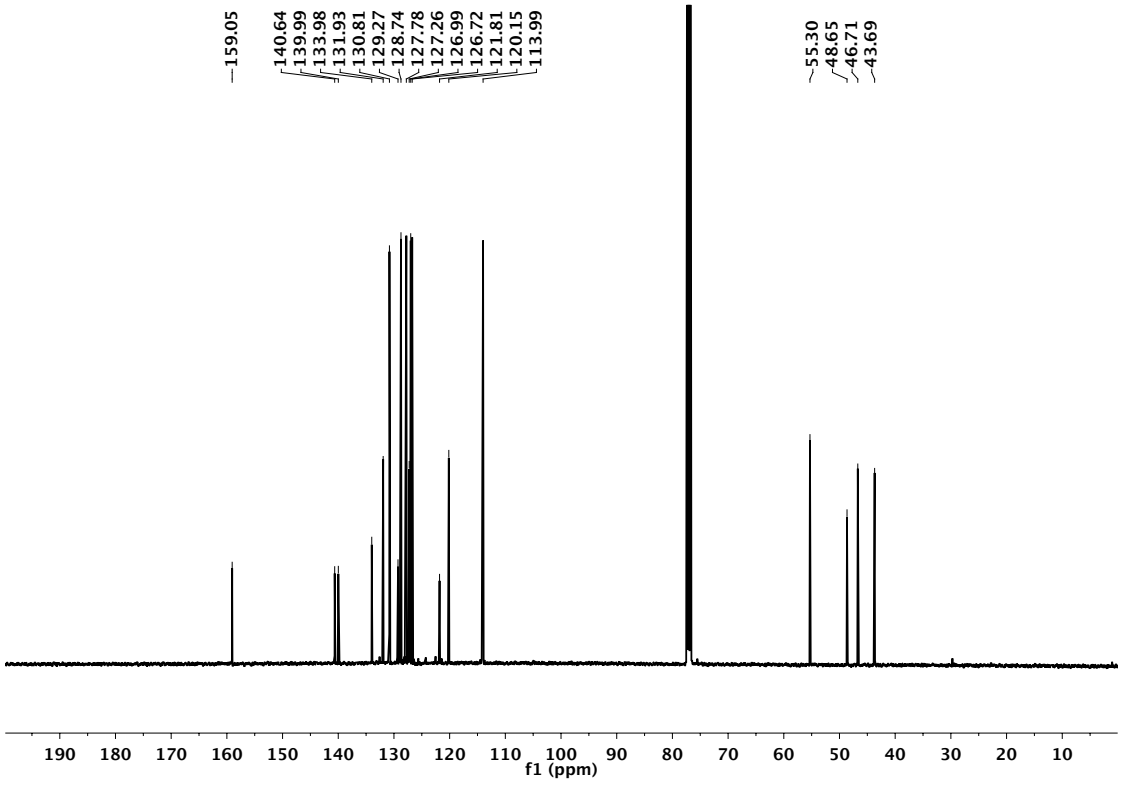
2-([1,1'-biphenyl]-4-ylmethyl)-2-phenylpent-4-enenitrile (**3j**)



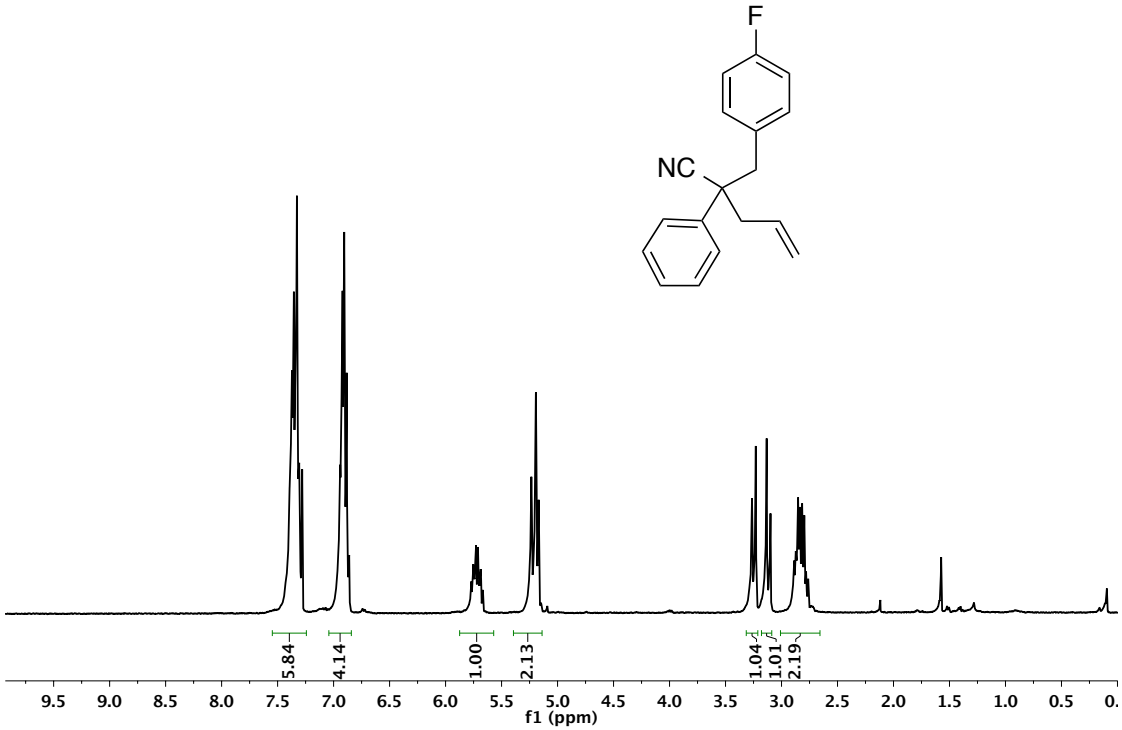


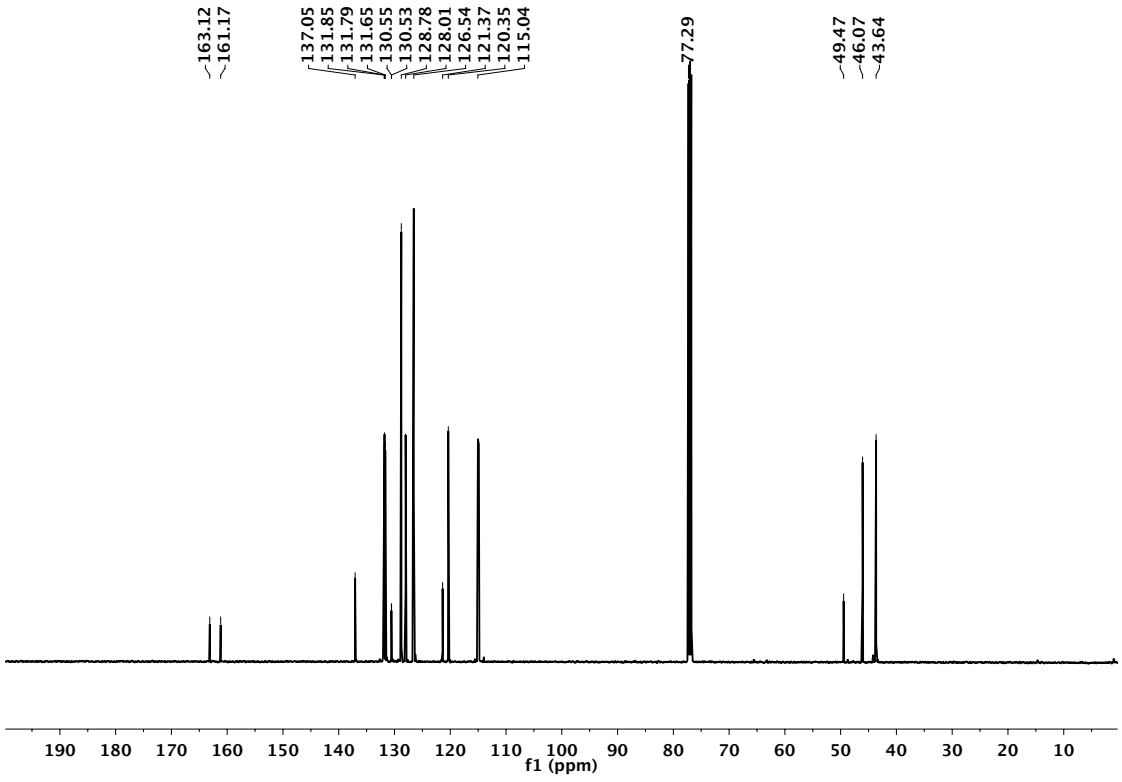
2-([1,1'-biphenyl]-4-ylmethyl)-2-(4-methoxyphenyl)pent-4-enenitrile (**3k**)



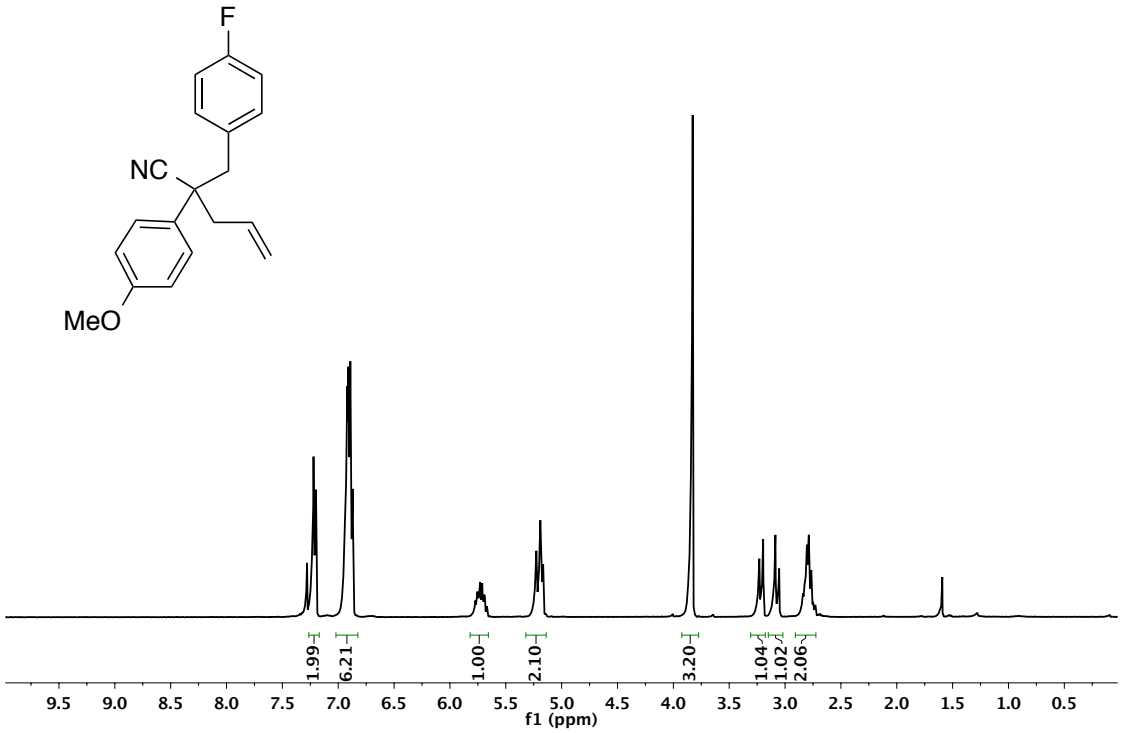


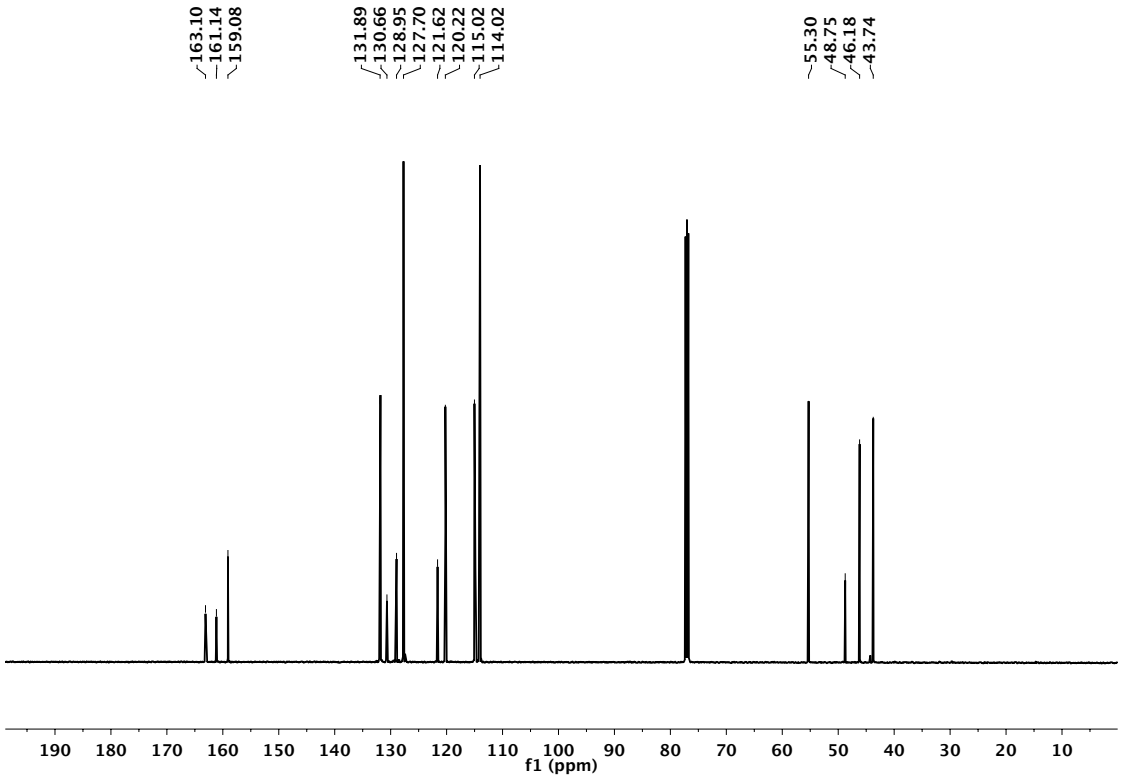
2-(4-fluorobenzyl)-2-phenylpent-4-enenitrile (**3l**)



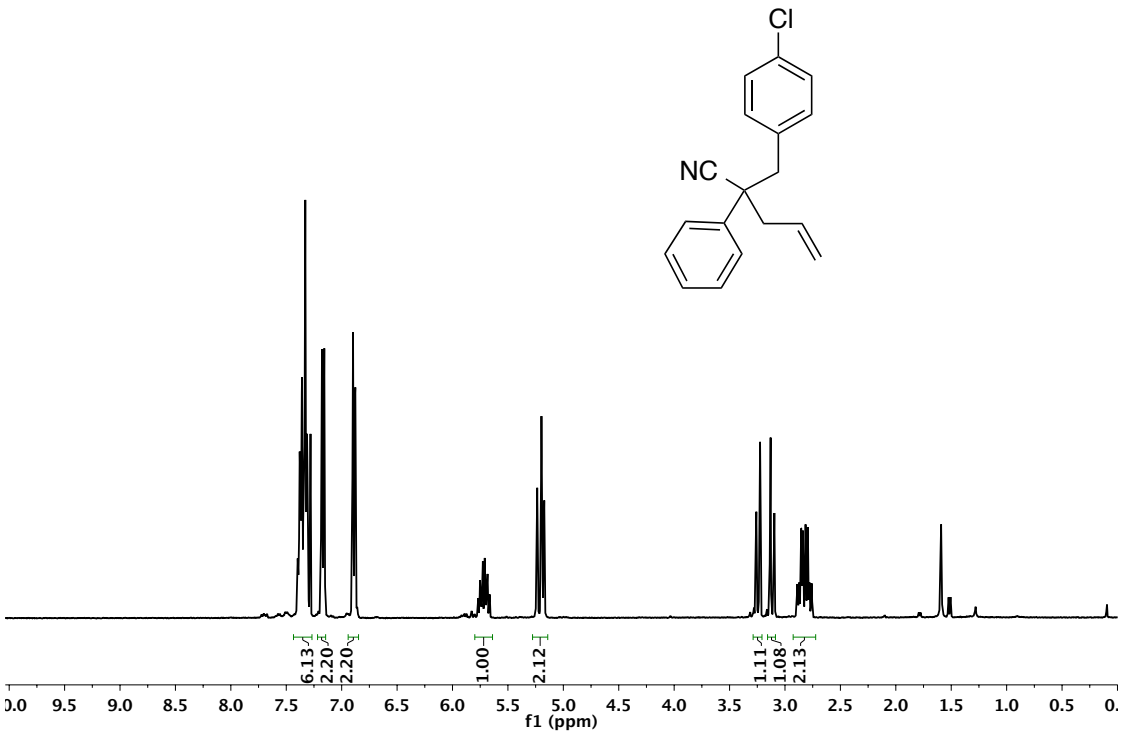


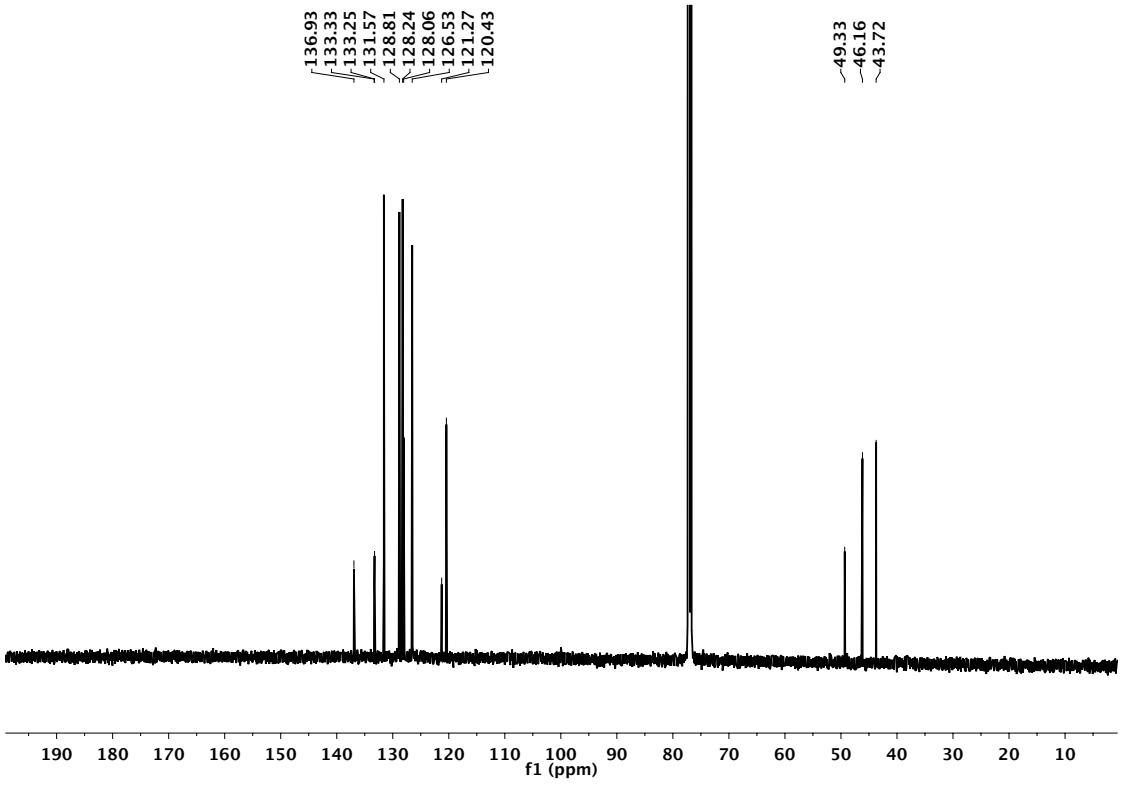
2-(4-fluorobenzyl)-2-(4-methoxyphenyl)pent-4-enenitrile (**3m**)



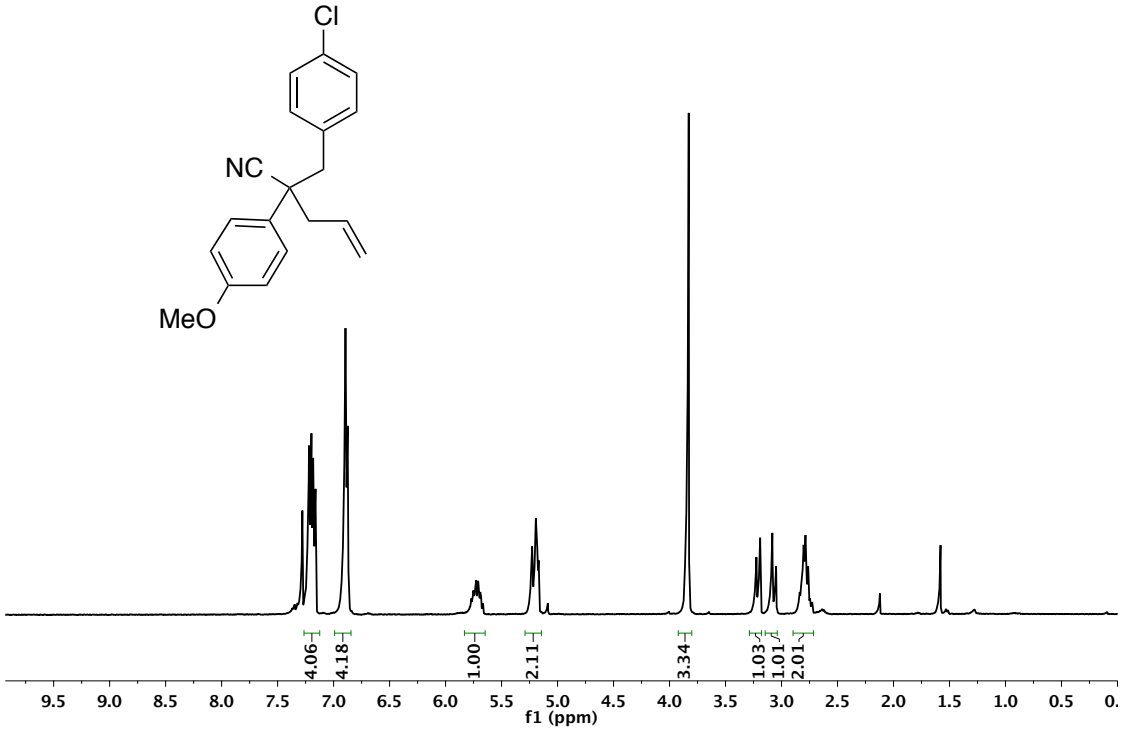


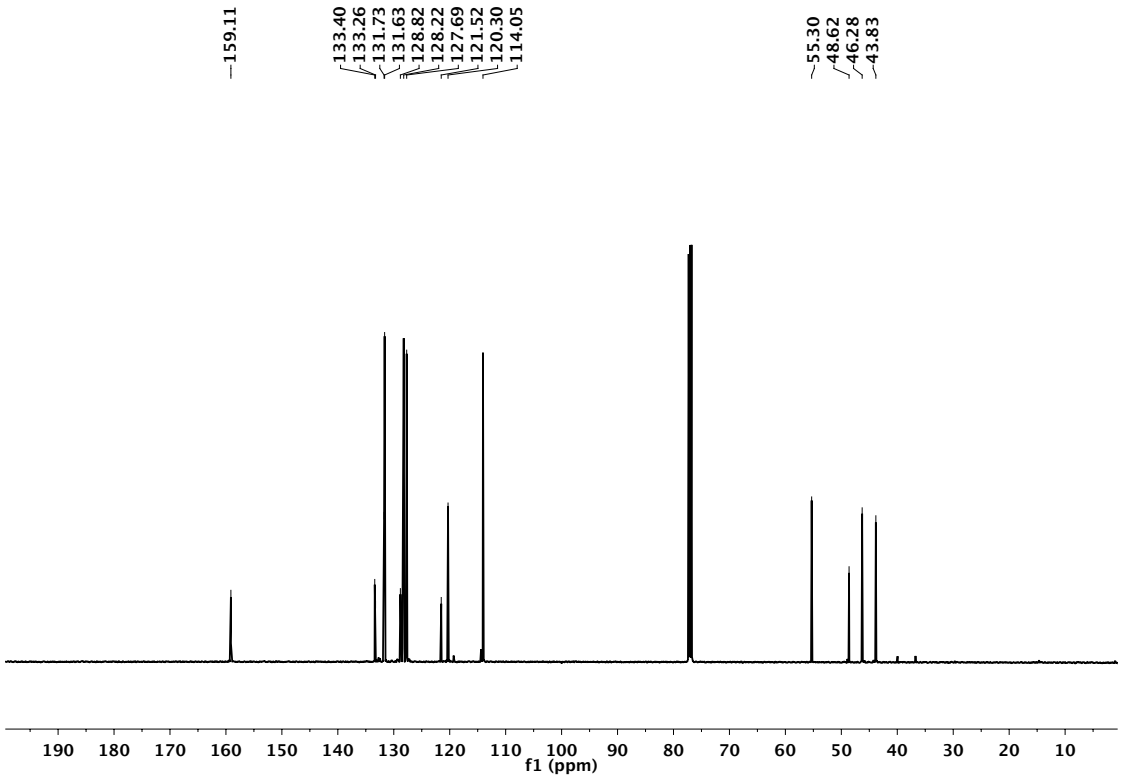
2-(4-chlorobenzyl)-2-phenylpent-4-enenitrile (**3n**)



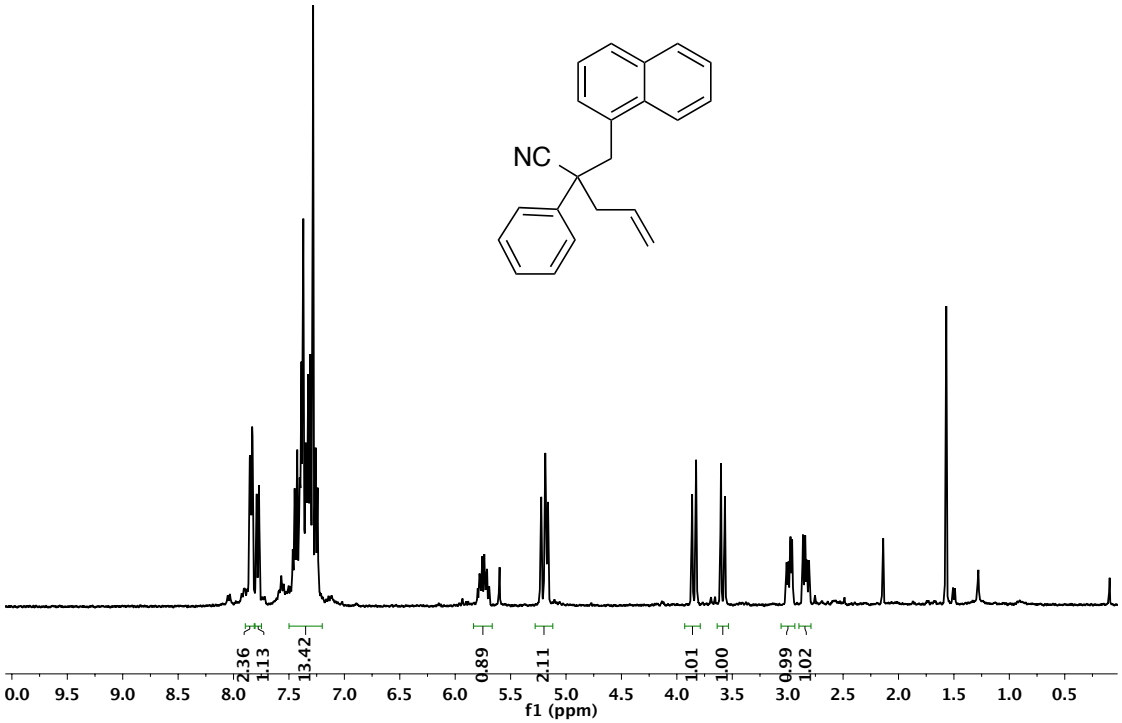


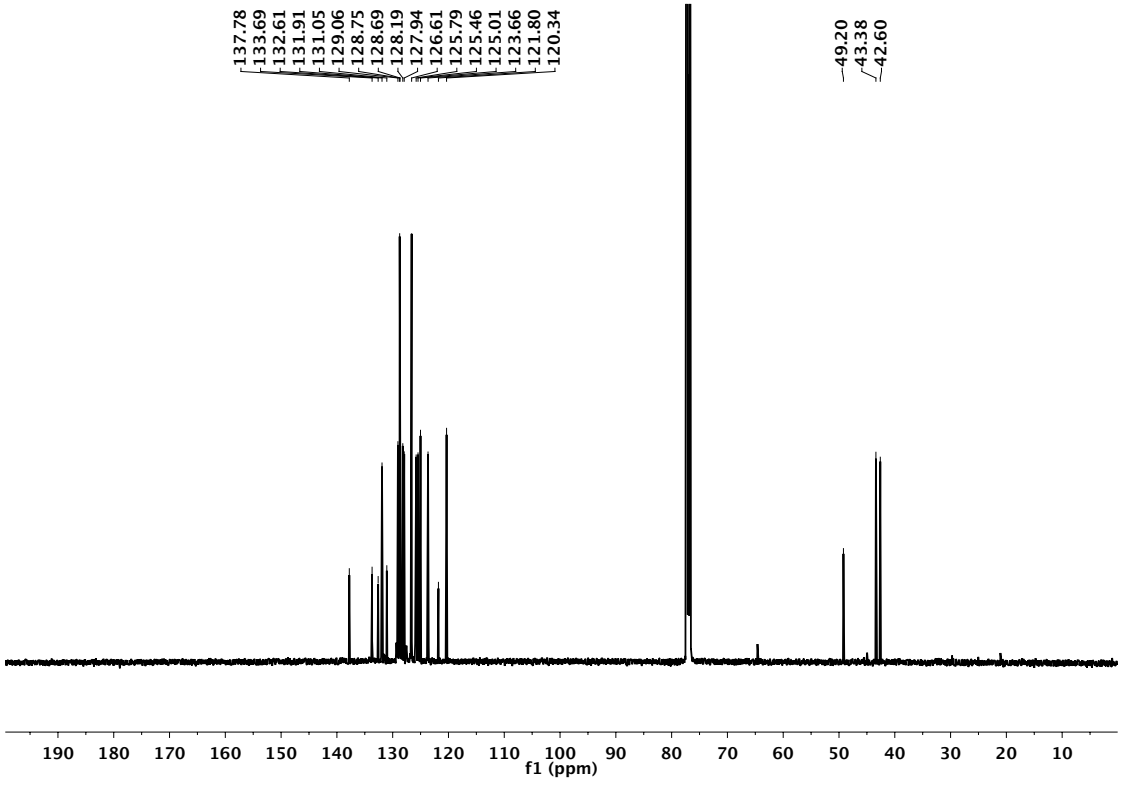
2-(4-chlorobenzyl)-2-(4-methoxyphenyl)pent-4-enenitrile (**3o**)



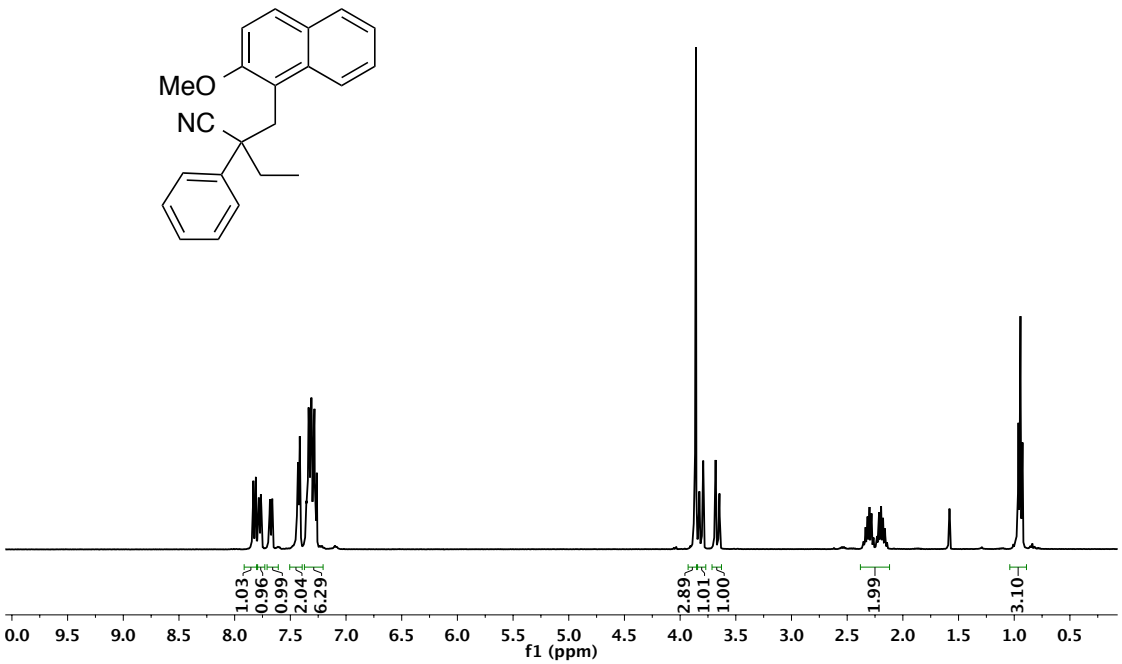


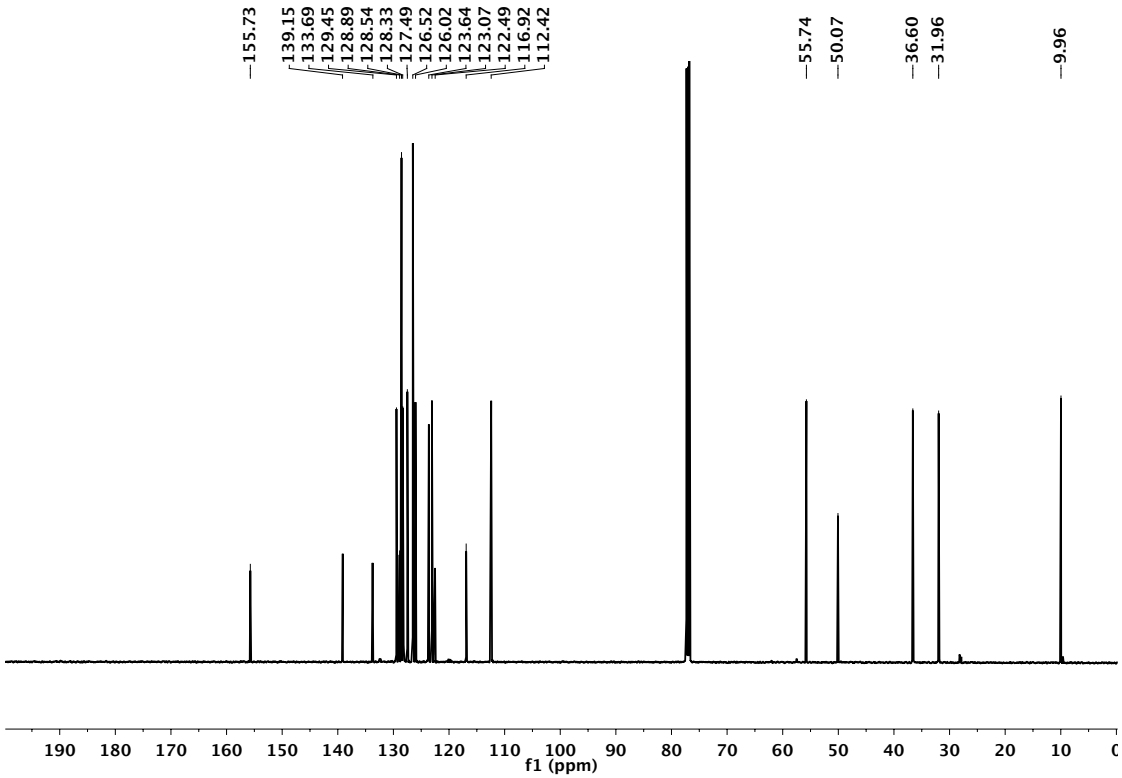
2-(naphthalen-1-ylmethyl)-2-phenylpent-4-enenitrile (**3p**)



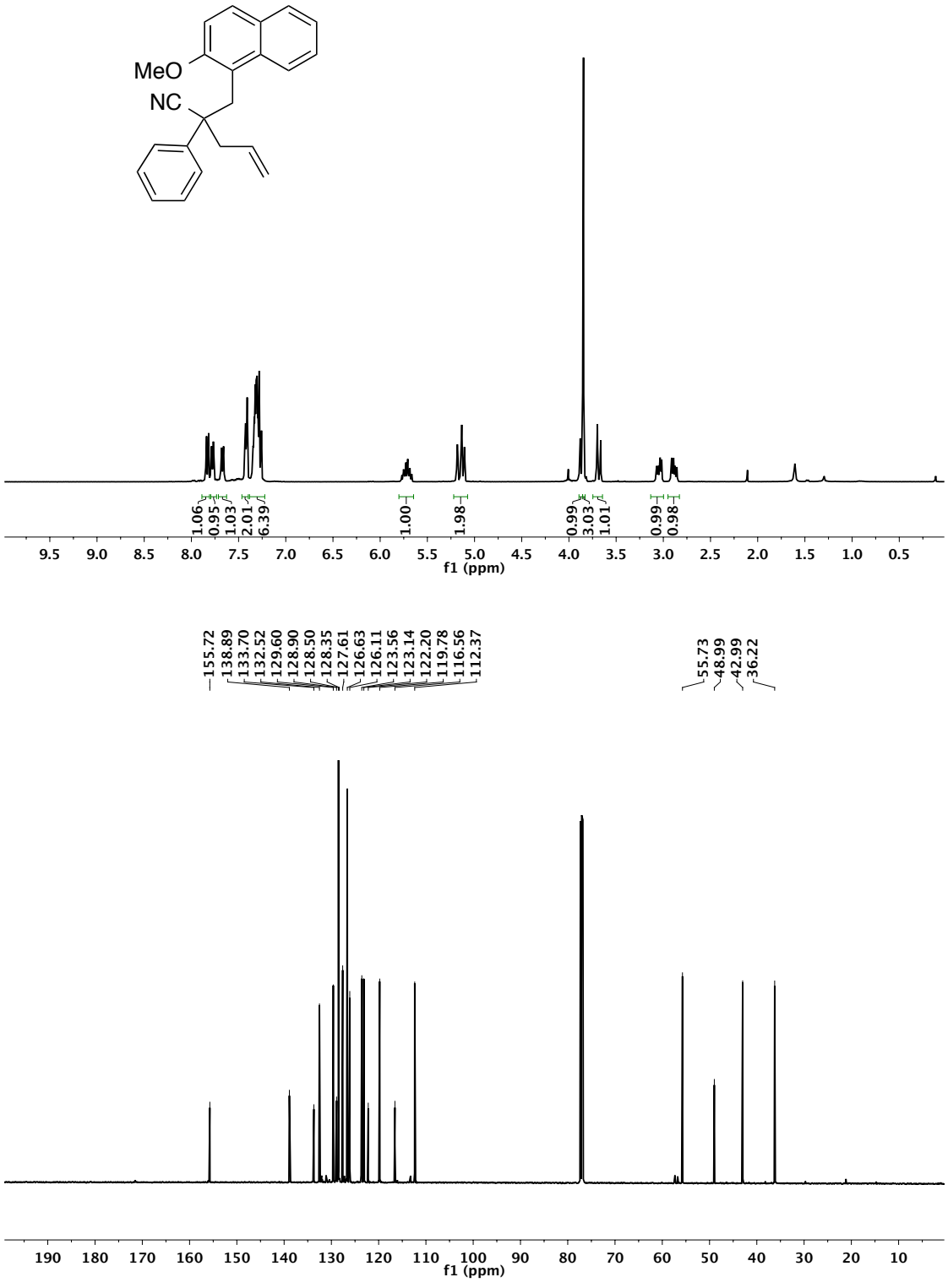


2-((2-methoxynaphthalen-1-yl)methyl)-2-phenylbutanenitrile (**3q**)

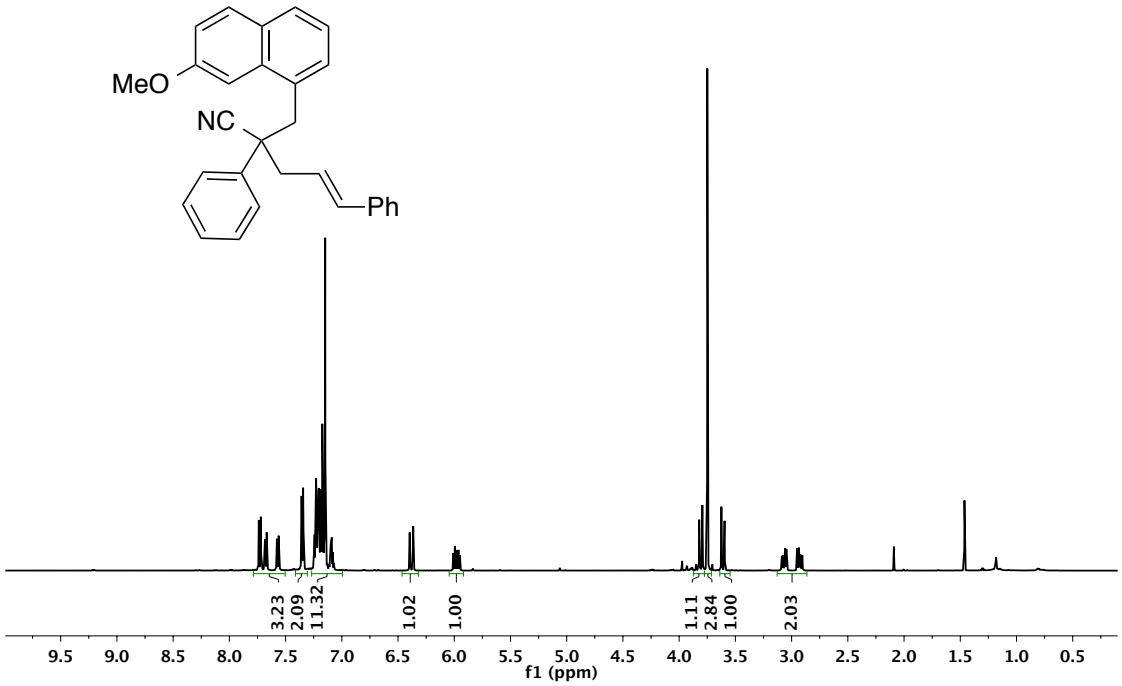


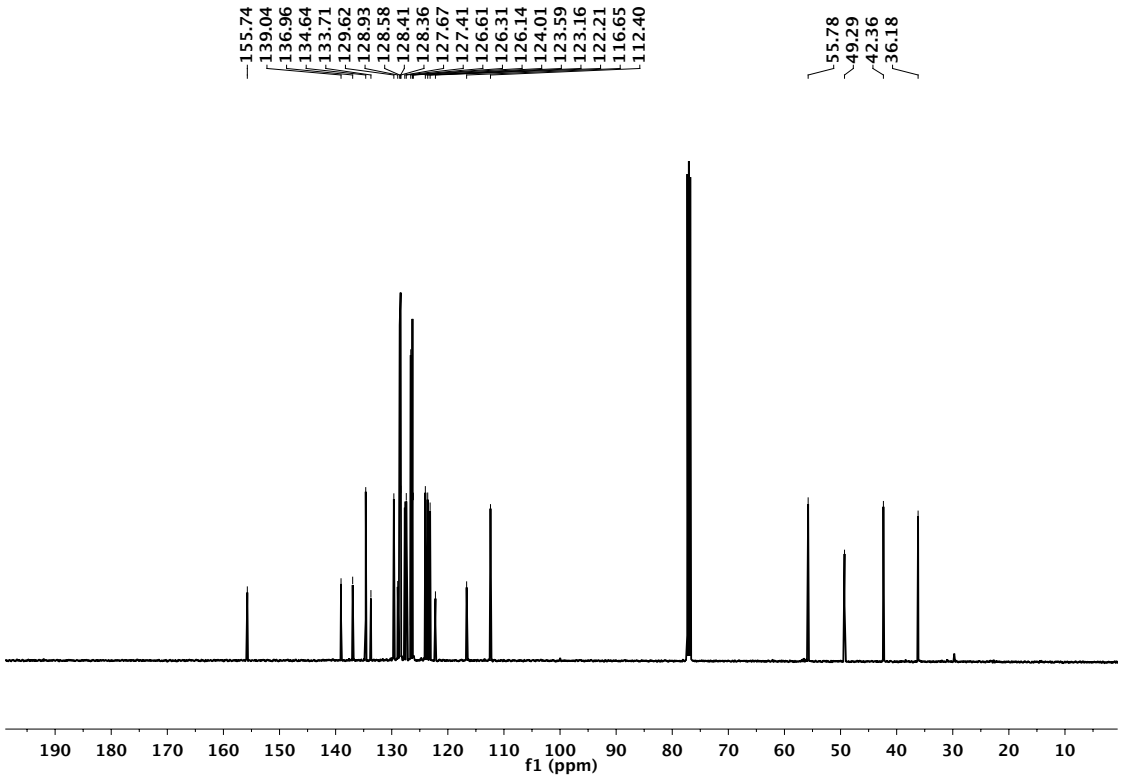


2-((2-methoxynaphthalen-1-yl)methyl)-2-phenylpent-4-enenitrile (**3r**)

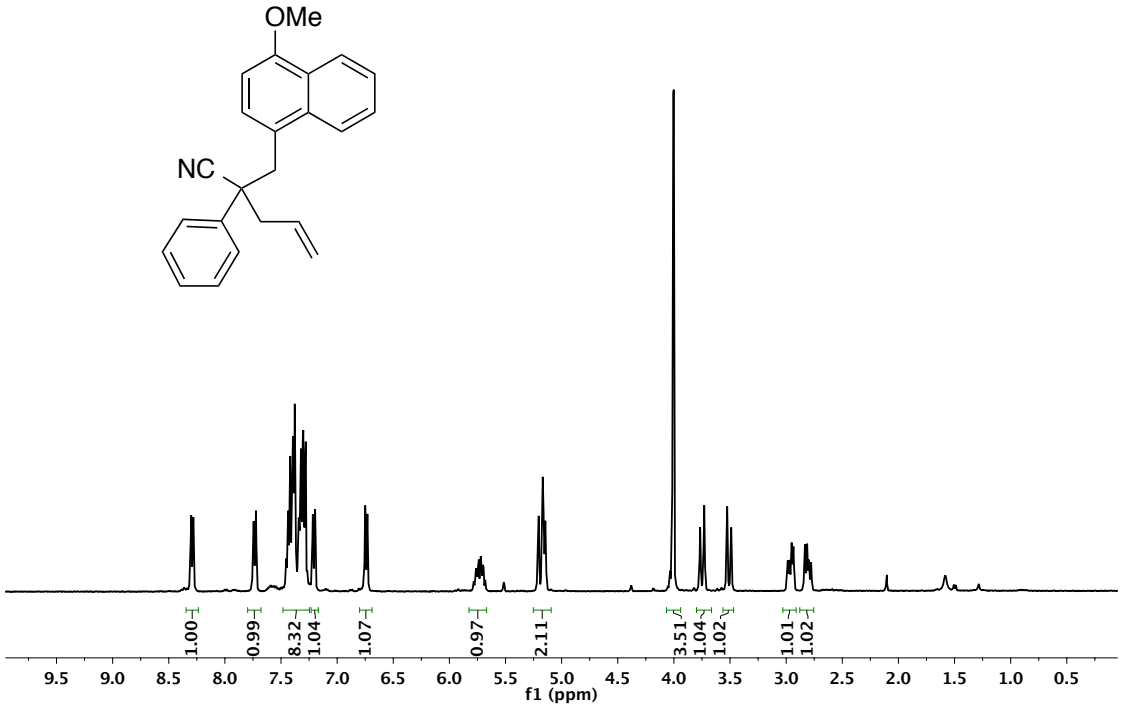


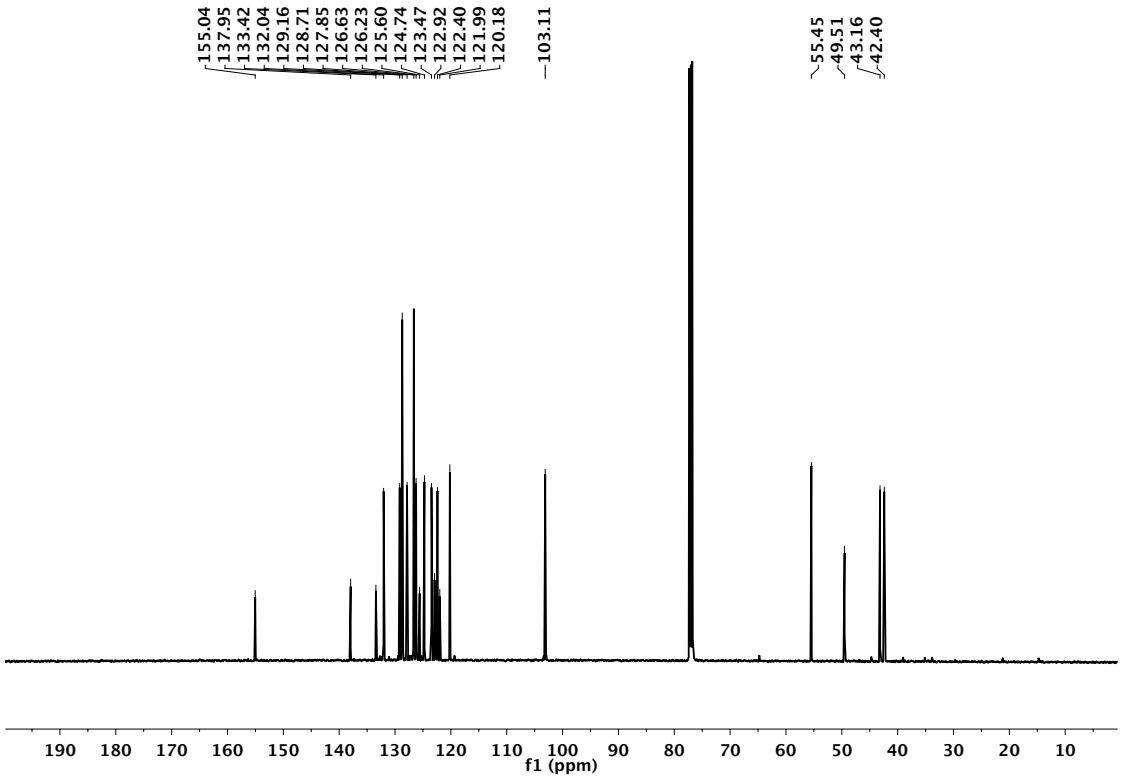
(*E*)-2-((7-methoxynaphthalen-1-yl)methyl)-2,5-diphenylpent-4-enenitrile (**3s**)



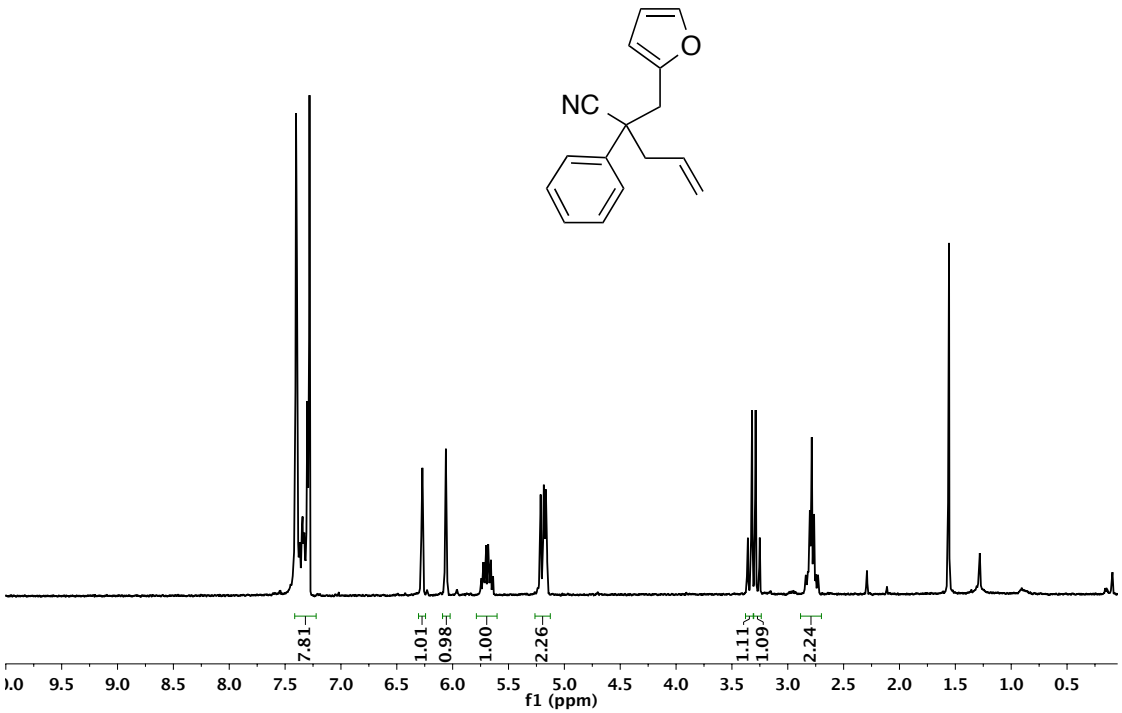


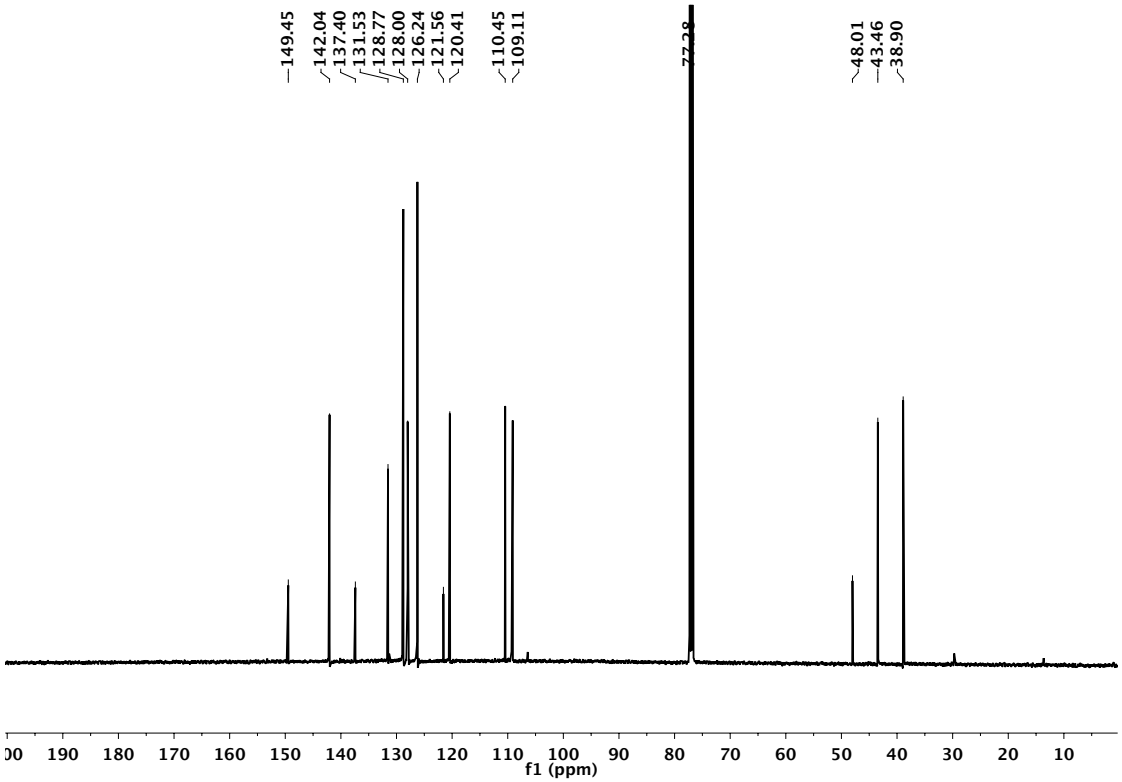
2-((4-methoxynaphthalen-1-yl)methyl)-2-phenylpent-4-enenitrile (**3t**)



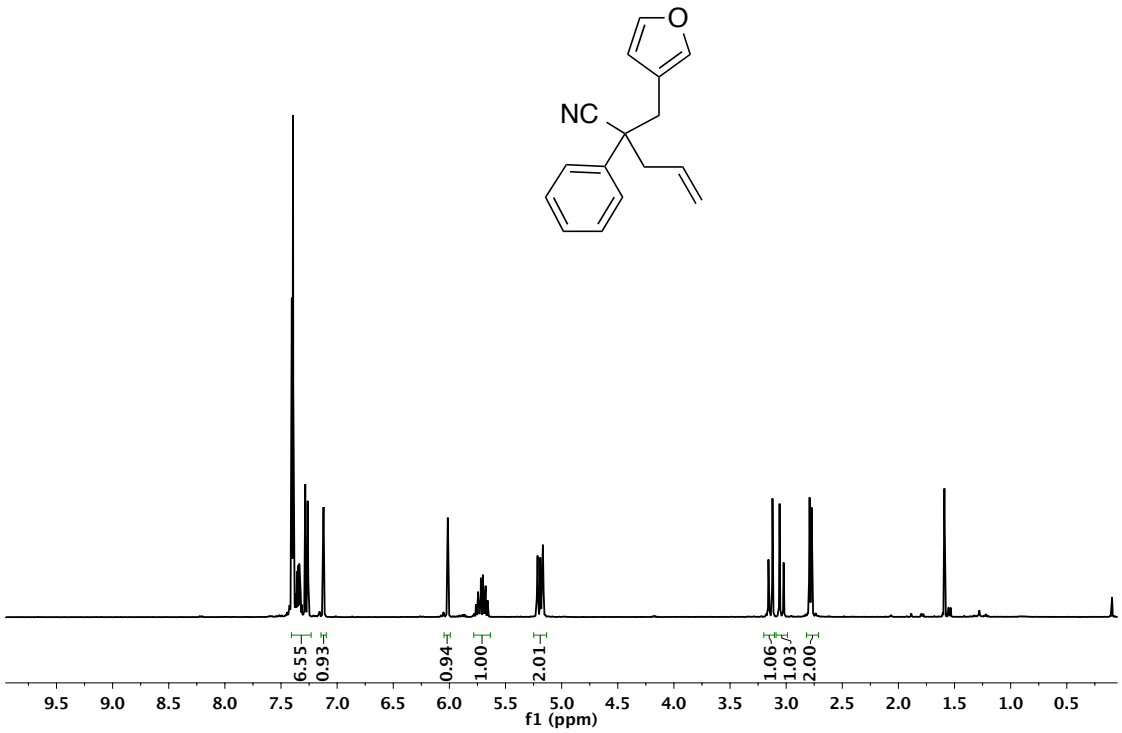


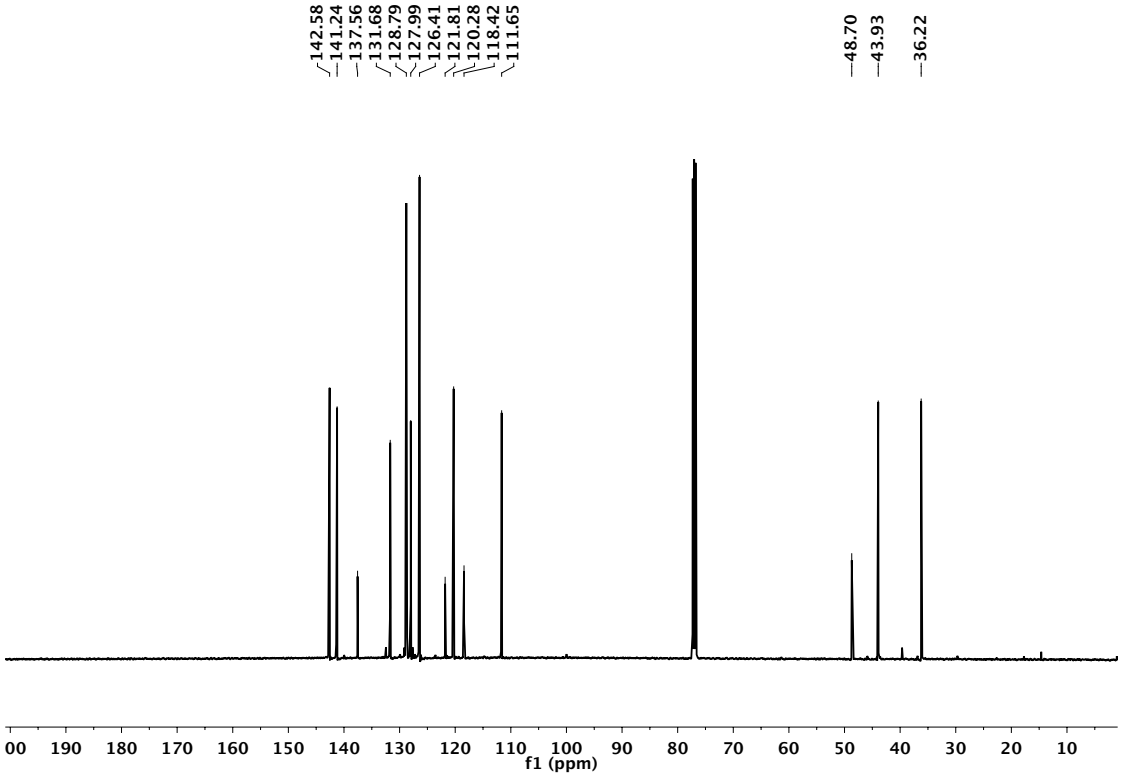
2-(furan-2-ylmethyl)-2-phenylpent-4-enenitrile (**3u**)



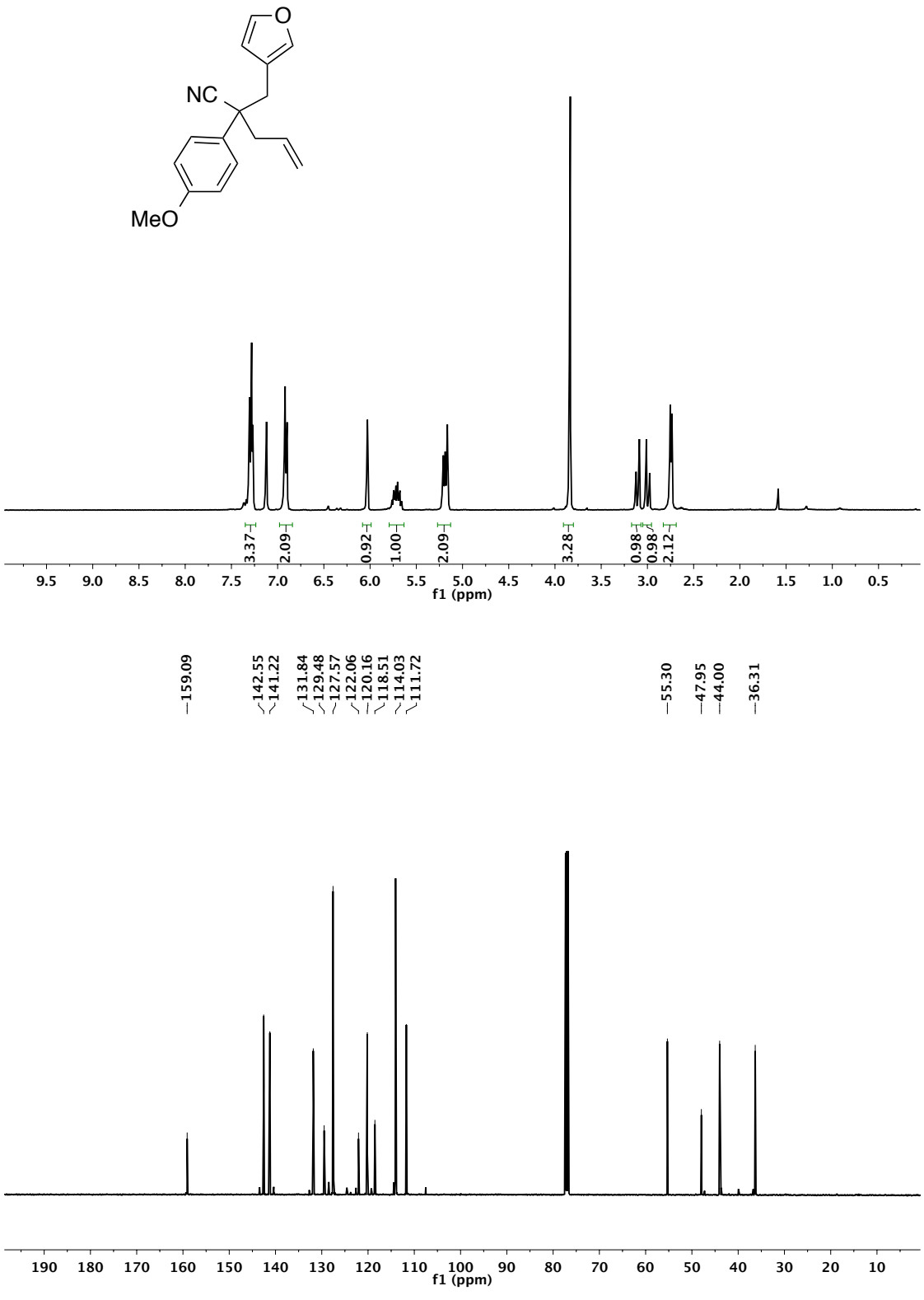


2-(furan-3-ylmethyl)-2-phenylpent-4-enenitrile (**3v**)

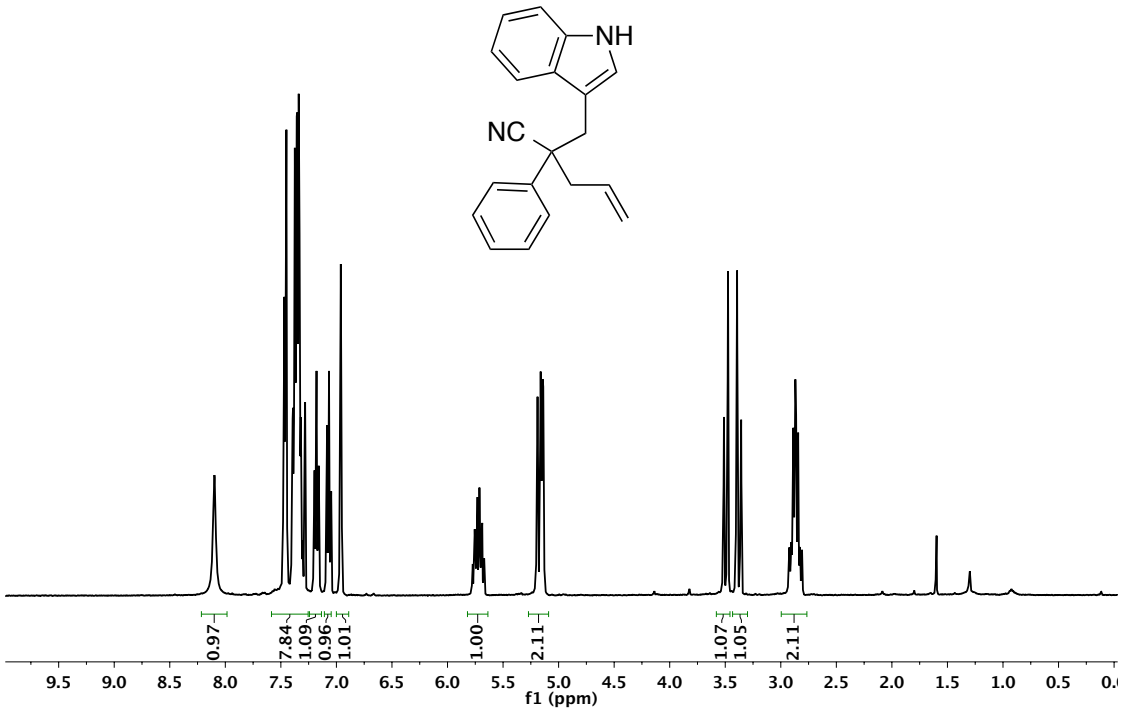


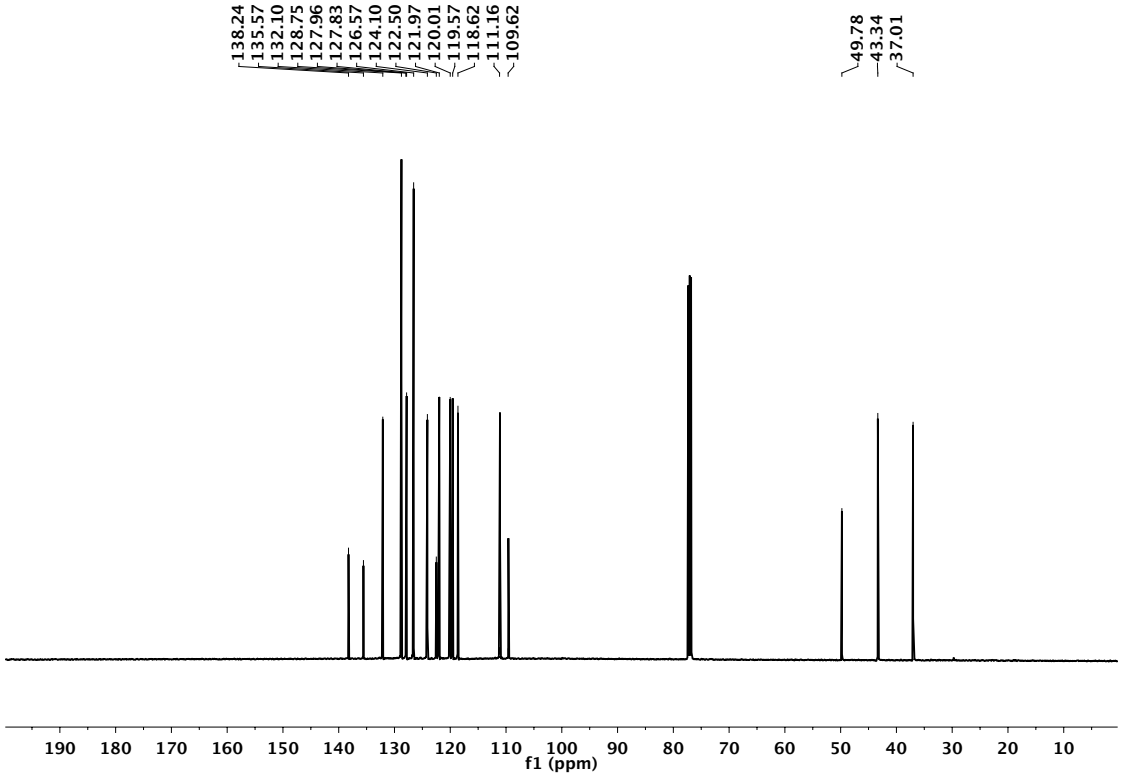


2-(furan-3-ylmethyl)-2-(4-methoxyphenyl)pent-4-enenitrile (**3w**)

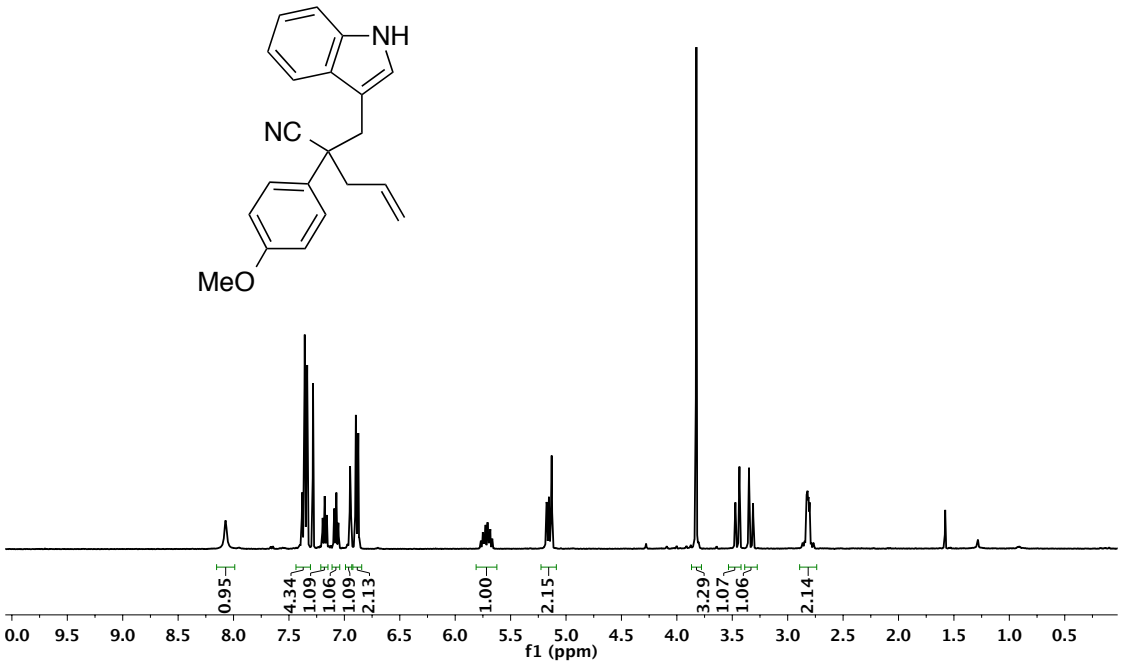


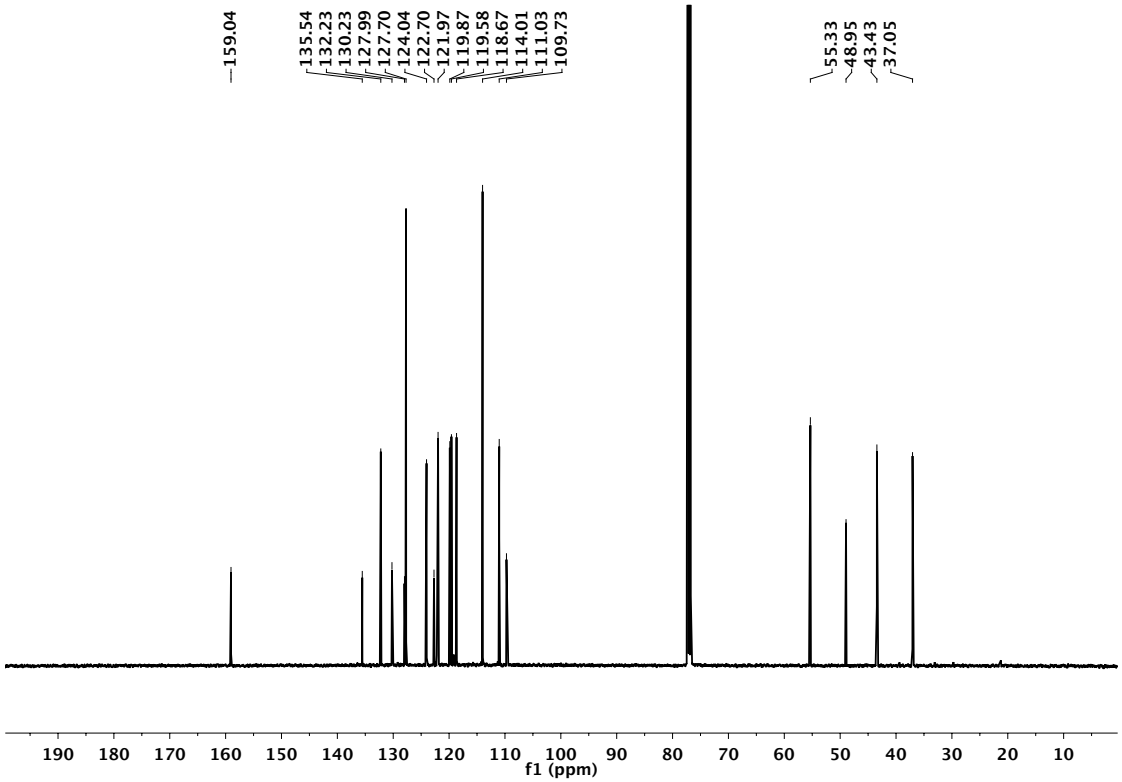
2-((1*H*-indol-3-yl)methyl)-2-phenylpent-4-enenitrile (**3x**)



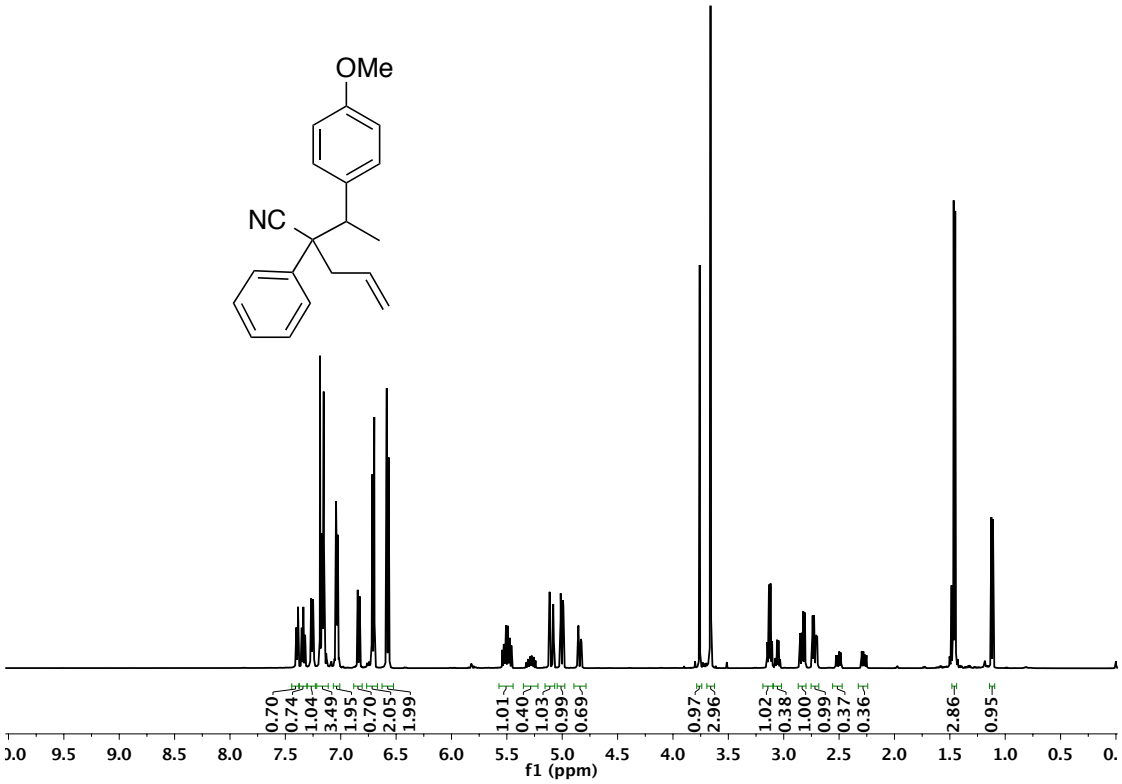


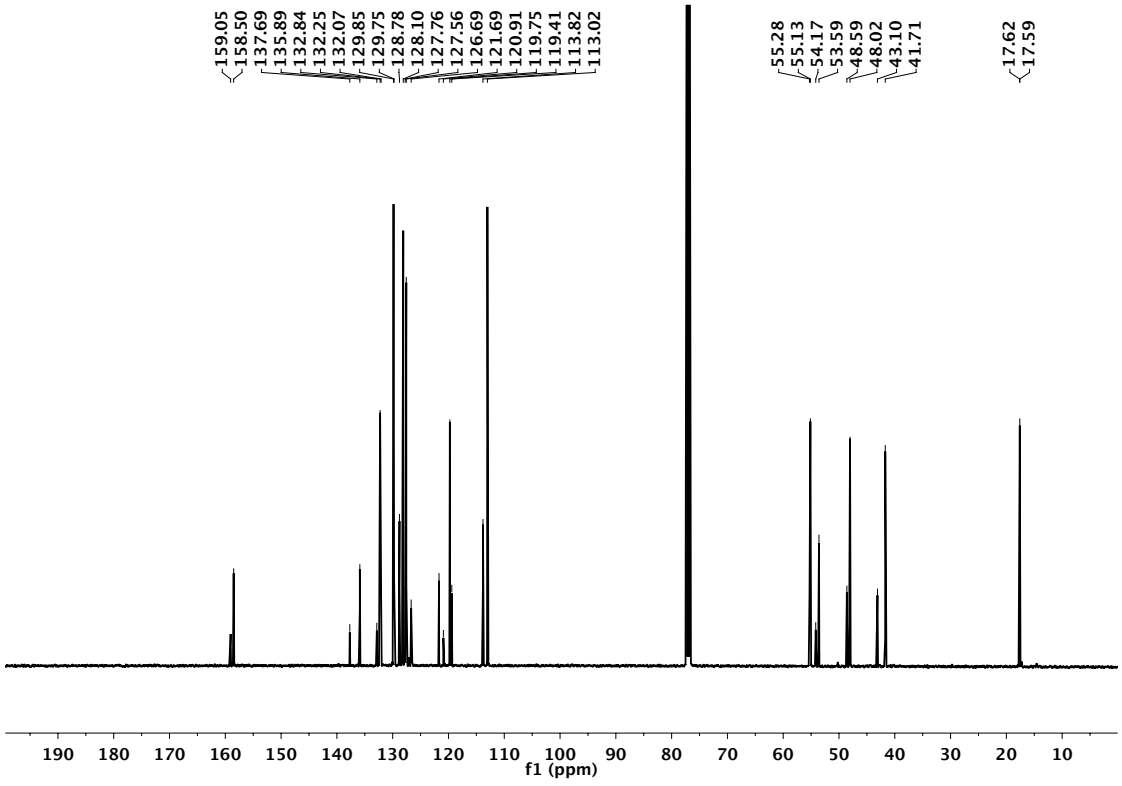
2-((1*H*-indol-3-yl)methyl)-2-(4-methoxyphenyl)pent-4-enenitrile (**3y**)





2-(1-(4-methoxyphenyl)ethyl)-2-phenylpent-4-enenitrile (**3A**)





2-phenyl-2-(1,2,3,4-tetrahydronaphthalen-1-yl)pent-4-enenitrile (**3B**)