*Supporting Information to Accompany:*

**Superior Reactivity of Thiosemicarbazides in the Synthesis of 2-Amino-1,3,4-Oxadiazoles:**

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**General**

Reactions were carried out under an atmosphere of dry nitrogen. Reagents and solvents were used as received from commercial sources. $^{1}$H NMR spectra were recorded on 400 MHz spectrometer. Chemical shifts are reported in ppm from tetramethylsilane with the solvent resonance as the internal standard (DMSO-$d_6$: δ 2.49). Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, br = broad, m = multiplet), coupling constants (Hz) and integration. $^{13}$C NMR spectra were recorded on a 100 MHz spectrometer with complete proton decoupling. Chemical shifts are reported in ppm from tetramethylsilane with the solvent as the internal reference (DMSO-$d_6$: δ 39.5). $^{19}$F NMR spectra were recorded on 375 MHz spectrometer with complete proton decoupling. Chemical shifts are reported in ppm with α,α,α-trifluorotoluene added as an internal reference (δ -62.7). All compounds except were characterized using the same HPLC conditions: gradient elution: (0.1% $H_3PO_4$/$CH_3CN$ 70:30 to 5:95 over 25 min, hold 5 min), flow rate = 2.0 mL/min, T = 35 °C, UV detection at 210 nm.

**Representative Procedures:**

**(1) Hydrazide acylation with isocyanate or isothiocyanate.** Phenyl acetic acid hydrazide (2.0 g, 13.3 mmol) and benzyl isothiocyanate (1.77 mL, 13.3 mmol) were combined in THF (50 mL) at room temperature. The resultant solution was stirred for 18 h, then volatiles were removed *in vacuo* to afford an off-white solid. The solid was suspended and triturated in MTBE (50 mL) for 1 h, then filtered to afford 3.80 g (95 % yield) of desired thiosemicarbazide.

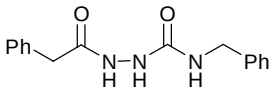
**(2) Cyclization to oxadiazole.** N-Benzyl-phenyl acetic acid thiosemicarbazide **1b** (2.05 g, 6.85 mmol) tosyl chloride (1.57 g, 8.22 mmol) and pyridine (1.16 mL, 14.4 mmol) were combined in THF (30 mL) in a 100 mL round-bottom flask fitted with a magnetic stir-bar, reflux condenser and nitrogen inlet. The solution was heated in a 70 °C oil bath to bring the mixture to reflux for 20 h, then cooled to room temperature. An aliquot of the crude reaction mixture indicated complete conversion (no thiosemicarbazide visible by LC) to the oxadiazole, with 97 % assay yield. EtOAc (20 mL) and 1N HCl (20 mL) were added; the mixture was vigorously stirred for 5 min, then the aqueous layer was removed. The aqueous layer was back-extracted with EtOAc (20 mL), then the combined organic layers were flushed with heptane (2 x 75 mL) and the material concentrated to an orange slurry. The material was dissolved in ~10 mL THF and filtered over solka-floc. HCl (3.43 mL, 2.0M in diethyl ether) was added to the solution. After stirring 30 min at room temperature, a thin slurry was obtained. MTBE was added dropwise to the slurry (25 mL) and the resultant mixture stirred an additional 25 min. The slurry was filtered to afford 1.74 g of shiny white powder (84 % yield).

**(3) One-pot acylation / cyclization procedure.** Phenyl acetic acid hydrazide (2.17 g, 14.4 mmol) and benzyl isothiocyanate (1.92 mL, 14.4 mmol) were combined in THF (50 mL) in a 100-Ml round-bottom flask at room temperature and stirred for 18 h. Tosyl chloride (3.30 g, 17.3 mmol) and pyridine (2.45 mL, 30.3 mmol) were added to the reaction mixture. The flask was fitted with a reflux condenser and nitrogen inlet and submerged into a 70 °C oil bath. The solution was heated to reflux in an oil bath for 20 h, then cooled to room temperature. An aliquot of the crude reaction mixture indicated complete conversion (no thiosemicarbazide visible by LC) to the oxadiazole, with 97 % assay yield. EtOAc (50 mL) and 1N HCl (50 mL) were added; the mixture was vigorously stirred for 5 min, then the aqueous layer was removed. The aqueous layer was back-extracted with EtOAc (50 mL), then the combined organic layers were flushed with heptane (2 x 150 mL) and the material

concentrated to an orange slurry. The material was dissolved in ~35 mL THF and filtered over solka-floc. HCl (14.4 mL, 1.0M in diethyl ether) was added to the solution. After stirring 30 min at room temperature, a thin slurry was obtaned. MTBE was added dropwise to the slurry (70 mL) and the resultant mixture stirred an additional 25 min. The slurry was filtered to afford 3.70 g of shiny white powder (85 % yield).

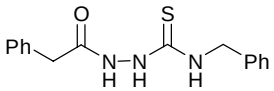
**Characterization Data:**

***N*-Benzyl-phenyl acetic acid semicarbazide (1a): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.77 (s, 1H)



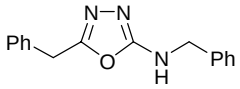
7.88 (s, 1H) 7.25 (m, 10H) 6.90 (s (br), 1H) 4.22 (d, *J* = 6.0Hz, 2H) 3.44 (s, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 170.1 158.2 140.5 135.8 129.1 128.2 128.1 126.9 126.5 126.4 42.6. **HPLC** Retention time: 4.39 min. **m.p.** 197.0 – 198.0 °C. **IR** 3333.9 (s) 3210.0 (s) 3030.2 (s) 1947.3 (w) 1695.9 (s) 1560.0 (s) 1452.4 (s) 1362.6 (m) 1274.0 (s) 1154.2 (m) 1074.6 (m). HRMS Calcd for $C_{16}H_{17}N_3O_2$: 284.1399. Found: 284.1401.

***N*-Benzyl-phenyl acetic acid *thio*-semicarbazide (1b): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.0 (s,



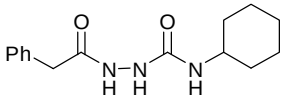
1H) 9.35 (s, 1H) 8.51 (s (br), 1H) 7.25 (m, 10H) 4.73 (d, *J* = 6.0Hz, 2H) 3.47 (s, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 169.9 139.2 135.4 129.3 128.1 128.0 127.0 126.5 46.7. **HPLC** Retention time: 6.78 min. **m.p.** 170.1 – 171.0 °C. **IR** 3336.3 (s) 3201.9 (s) 3030.4 (s) 1948.5 (w) 1683.2 (s) 1653.5 (s) 1604.6 (m) 1555.2 (s) 1492.8 (s) 1378.1 (s) 1292.5 (s) 1186.8 (s) 1074.5 (s). HRMS Calcd for $C_{16}H_{17}N_3OS$: 300.1171. Found: 300.1174.

**Benzyl-(5-benzyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (2): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 7.99 (t,



*J* = 6.0Hz, 1H) 7.30 (m, 10H) 4.31 (d, *J* = 6.0Hz, 2H) 4.04 (s, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 163.7 158.5 138.8 135.1 128.7 128.3 127.3 127.1 127.0 46.0 30.9 **HPLC** Retention time: 7.79 min. **m.p.** 157.0 – 157.5 °C. **IR** 2948.7 (m) 2550.5 (m) 1734.8 (s) 1714.7 (s) 1638.3 (s) 1496.8 (m) 1453.8 (m) 1415.1 (w) 1214.4 (w) 1011.0 (m). HRMS Calcd for $C_{16}H_{15}N_3O$: 266.1293. Found: 266.1290.

***N*-Cyclohexyl-phenyl acetic acid semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.72 (s, 1H)



7.64 (s, 1H) 7.30 (m, 5H) 6.02 (d, *J* = 8.0Hz, 2H) 3.49 (s, 2H) 3.35 (m, 1H) 1.71 – 1.49 (m, 5H) 1.25 – 1.05 (m, 5H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ

169.7 157.1 135.9 129.0 128.2 126.4 47.9 32.9 25.2 24.5. **HPLC** Retention time: 4.84 min. **m.p.** 225.0 – 226.0 °C. **IR** 3331.0 (s) 3216.1 (s) 3028.1 (m) 2928.6 (s) 2852.9 (s) 1692.1 (s) 1558.4 (s) 1496.6 (s) 1348.9 (m) 1272.1 (m) 1234.3 (s) 1166.4 (s) 1049.3 (m). HRMS Calcd for $C_{15}H_{21}N_3O_2$: 276.1712. Found: 276.1710.

***N*-Cyclohexyl-phenyl acetic acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-$d_6$)** δ 9.91 (s, 1H) 9.13 (s, 1H) 7.24 (m, 5H) 4.04 (br, 1H) 3.46 (s, 2H) 1.79 – 1.57 (m, 5H) 1.33 – 1.11 (m, 5H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 169.9 135.6 129.1 128.2 126.5 67.0 52.5 31.8 25.1 24.7. **HPLC** Retention time: 7.42 min. **m.p.** 186.4 – 188.0 °C. **IR** 3224.2 (s) 2933.8 (s) 2852.9 (s) 1681.9 (s) 1554.3 (s) 1498.2 (s) 1453.1 (m) 1408.1 (m) 1281.2 (m) 1151.8 (m) 1049.6 (m). HRMS Calcd for $C_{15}H_{21}N_3OS$: 292.1484. Found: 292.1479.

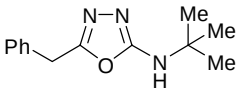
**Cyclohexyl-(5-benzyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (3): $^1$H NMR (400 MHz, dmso-$d_6$)** δ 7.29 (m, 6H) 4.02 (s, 2H) 3.26 (m, 1H) 1.87 (m, 2H) 1.67 (m, 2H) 1.53 (m, 2H) 1.16 (m, 5H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 163.0 127.9 135.2 128.6 127.0 51.6 32.2 30.9 25.2 24.3. **HPLC** Retention time: 8.46 min. **m.p.** 199.0 – 202.0 °C. **IR** 3233.4 (m) 3109.4 (m)2929.0 (s) 2857.4 (s) 2587.1 (s) 1717.4 (s) 1647.3 (s) 1497.2 (m) 1455.4 (m) 1337.5 (m) 1271.4 (m) 1081.8 (m) 1017.2 (s). HRMS Calcd for $C_{15}H_{19}N_3O$: 258.1606. Found: 258.1606.

***N*-*tert*-Butyl-phenyl acetic acid semicarbazide: $^1$H NMR (400 MHz, dmso-$d_6$)** δ 9.74 (s, 1H) 7.54 (s, 1H) 7.28 (m, 5H) 5.85 (s (br), 1H) 3.41 (s, 2H) 1.20 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 169.6 126.9 135.9 129.0 128.2 126.4 49.4 29.0. **HPLC** Retention time: 3.84 min. **m.p.** 190.1 – 191.2 °C. **IR** 3323.6 (s) 3248.5 (s) 3101.9 (m) 2971.5 (s) 2929.8 (w) 1694.0 (s) 1616.2 (s) 1575.6 (s) 1497.7 (m) 1391.7 (m) 1277.9 (s) 1223.2 (s) 1149.7 (s). HRMS Calcd for $C_{13}H_{19}N_3O_2$: 250.1556. Found: 250.1561.

***N*-*tert*-Butyl-phenyl acetic acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-$d_6$)** δ 10.0 (s, 1H) 9.09 (s, 1H) 7.25 (m, 6H) 3.49 (s, 2H) 1.35 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 169.5 135.6 129.0 128.9 128.3 128.2 126.6 126.3 67.0 52.6 28.5 25.1. **HPLC** Retention time: 6.48 min. **m.p.** 137.3 – 138.4 °C. **IR** 3223.7 (s) 2924.9 (s) 1673.7 (s)

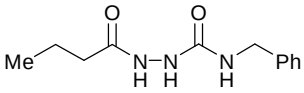
1551.8 (s) 1498.7 (s) 1460.4 (m) 1279.6 (m) 1149.2 (m) 1051.0 (m). RMS Calcd for $C_{13}H_{19}N_3OS$: 266.1327. Found: 266.1320.

***N*-*tert*-Butyl-(5-benzyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (4): $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ



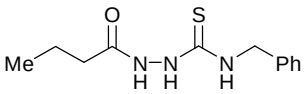
7.33 (m, 1H) 7.25 (m, 4H) 4.03 (s, 2H) 1.27 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 159.1 158.2 141.3 134.0 129.0 128.7 127.5 127.3 125.6 52.4 30.7 28.1. **HPLC** Retention time: 6.83 min. **m.p.** 138.1 – 140.2 °C. **IR** 3237.0 (w) 3126.7 (s) 2985.1 (s) 2848.5 (s) 2642.9 (s) 1707.1 (s) 1684.9 (s) 1654.0 (w) 1638.7 (s) 1497.3 (m) 1376.3 (m) 1235.2 (m) 1082.2 (m). HRMS Calcd for $C_{13}H_{17}N_3O$: 232.1450. Found: 232.1444.

***N*-Benzyl-butyric acid semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.44 (s, 1H) 7.78 (s, 1H)



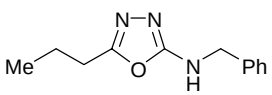
7.25 (m, 5H) 6.84 (t, *J* = 6.0Hz, 1H) 4.21 (d, *J* = 6.0Hz, 2H) 2.07 (t, *J* = 7.4Hz, 2H) 1.52 (m, 2H) 0.86 (t, *J* = 7.4Hz, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 172.1 158.3 140.6 128.1 126.9 126.5 42.6 35.1 18.3 13.6. **HPLC** Retention time: 2.73 min. **m.p.** 205.1 – 208.4 °C. **IR** 3390.5 (s) 3283.5 (m) 3192.0 (m) 2964.6 (m) 2873.4 (m) 1710.1 (s) 1652.8 (s) 1567.6 (s) 1540.4 (s) 1497.5(m) 1452.0 (m) 1273.1 (m) 1236.1 (m) 1175.1 (w) 1052.6 (w). HRMS Calcd $C_{12}H_{17}N_3O_2$: 236.1399. Found: 236.1396.

***N*-Benzyl-butyric acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.67 (s, 1H) 9.25 (s,



1H) 8.37 (s (br), 1H) 7.27 (m, 5H) 4.70 (d, *J* = 6.0Hz, 2H) 2.10 (t, *J* = 7.2Hz, 2H) 1.52 (m, 2H) 0.86 (t, *J* = 7.2Hz, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 172.0 139.4 128.0 127.0 126.6 46.6 35.2 18.0 13.7. **HPLC** Retention time: 4.55 min. **m.p.** 160.8 – 161.9 °C. **IR** 3504.3 (s) 3157.9 (s) 2960.1 (s) 1668.6 (s) 1568.2 (s) 1451.8 (s) 1392.2 (m) 1350.6 (s) 1279.2 (s) 1236.3 (s) 1189.3 (s) 1063.5 (m). HRMS Calcd $C_{12}H_{17}N_3OS$: 252.1171. Found: 252.1175.

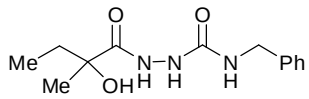
***N*-Benzyl-(5-butyl-[1,3,4]oxadiazol-2-yl)-amine (5): $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 7.92 (t, *J* =



4.8Hz, 1H) 7.31 (m, 4H) 7.25 (m, 1H) 4.33 (d, *J* = 4.8Hz, 2H) 2.60 (t, *J* = 5.6Hz, 2H) 1.60 (m, 2H) 0.90 (t, *J* = 6.0Hz, 3H). **$^{13}$C NMR (100 MHz,**

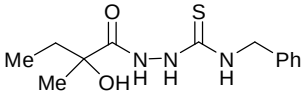
**dmso-*d*$_6$)** δ 163.4 159.6 138.9 128.3 127.3 127.0 46.0 26.4 19.4 13.3. **HPLC** Retention time: 5.67 min. **m.p.** 83.4 – 84.8 °C. **IR** 3214.8 (m) 3033.5 (m) 2963.8 (m) 1635.4 (s) 1584.5 (s) 1455.6 (m) 1333.7 (w) 1191.2 (m). HRMS Calcd $C_{12}H_{15}N_3O$: 218.1293. Found: 218.1295.

***N*-Benzyl-2-hydroxy-2-methyl-butyric acid semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ



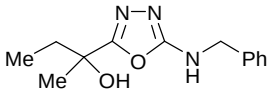

9.27 (s, 1H) 7.80 (s, 1H) 7.24 (m, 5H) 6.64 (t, *J* = 6.0Hz, 1H) 5.09 (s, 1H) 4.23 (d, *J* = 6.0Hz, 2H) 1.66 (m, 1H) 1.46 (m, 1H) 1.23 (s, 3H) 0.80 (t, *J* = 7.2Hz, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 175.4 158.5 140.4 128.1 126.9 126.6 74.6 42.6 32.9 25.9 7.9. **HPLC** Retention time: 2.33 min. **m.p.** 144.5 – 145.2 °C. **IR** 3368.7 (s) 3976.4 (w) 1682.7 (s) 1651.6 (s) 1504.8 (m) 1451.4 (m) 1364.6 (w) 1180.6 (m) 1044.1 (w). HRMS Calcd $C_{13}H_{19}N_3O_3$: 266.1505. Found: 266.1501.

***N*-Benzyl-2-hydroxy-2-methyl-butyric acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)**



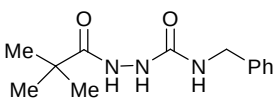

δ 9.76 (s, 1H) 9.37 (br s, 1H) 7.95 (s, 1H) 7.26 (m, 5H) 5.13 (s, 1H) 4.73 (m, 2H) 1.63 (m, 1H) 1.48 (m, 1H) 0.79 (t, *J* = 7.6Hz, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 182.0 139.0 128.1 126.9 126.7 74.8 46.7 32.7 25.5 7.9. **HPLC** Retention time: 3.85 min. **m.p.** 132.5 – 132.7 °C. **IR** 3519.1 (w) 3261.8 (s) 2975.0 (m) 1679.4 (s) 1550.3 (s) 1495.2 (m) 1306.8 (w) 1133.0 (m). HRMS Calcd $C_{13}H_{19}N_3O_2S$: 282.1276. Found: 282.1270.

***N*-Benzyl-(5-(2-hydroxy-2-methyl)-butyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (6): $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ



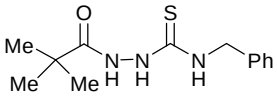

9.65 (br s, 1H) 7.40 (d, *J* = 7.6Hz, 2H) 7.35 (t, *J* = 7.6Hz, 2H) 7.28 (t, *J* = 7.2Hz, 1H) 4.50 (s, 2H) 1.74 (q, *J* = 7.6Hz, 2H) 1.41 (s, 3H) 0.81 (t, *J* = 7.6Hz, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 163.3 160.9 137.4 128.5 127.7 127.5 69.4 46.2 33.0 24.7 8.1. **HPLC** Retention time: 3.43 min. **m.p.** 132.0 – 133.1 °C. **IR** 3163.0 (s) 2971.4 (s) 1722.3 (s) 1623.9 (w) 1455.6 (m) 1381.9 (m) 1133.9 (s) 1014.1 (s). HRMS Calcd $C_{13}H_{17}N_3O_2$: 248.1399. Found: 248.1394.

***N*-Benzyl-*tert*-butyric acid semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.23 (s, 1H) 7.65 (s,

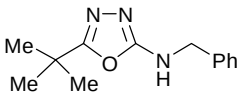



1H) 7.25 (m, 5H) 6.66 (t, *J* = 6.1Hz, 1H) 4.23 (d, *J* = 6.1Hz, 2H) 1.12 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 177.5 158.4 140.6 128.1 126.9 126.5 27.1. **HPLC** Retention time: 3.52 min. **m.p.** 153.2 – 154.5 °C. **IR** 3290.7 (s) 2965.7 (m) 1706.7 (s)

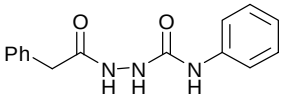
1625.5 (s) 1545.5 (s) 1452.7 (m) 1369.8 (m) 1235.0 (m). HRMS Calcd $C_{13}H_{19}N_3O_2$: 250.1556. Found: 250.1552.



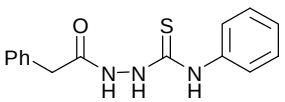
***N*-Benzyl-*tert*-butyric acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-$d_6$)** δ 9.49 (s, 1H) 9.20 (d, *J* = 10.7Hz, 1H) 8.04 (s, 1H) 7.35 (d, *J* = 54.4Hz, 4H) 7.22 (d, *J* = 6.5Hz, 1H) 4.75 (d, *J* = 5.9Hz, 2H) 1.15 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 139.4, 128.2, 128.0, 127.2, 126.9, 126.6, 46.7, 37.7, 27.0. **HPLC** Retention time: 5.86 min. **m.p.** 142.5 – 143.8 °C. **IR** 3289.2 (s) 2966.5 (s) 1635.8 (s) 1540.1 (s) 1457.3 (s) 1274.6 (s) 1078.8 (s). HRMS Calcd $C_{13}H_{19}N_3OS$: 266.1327. Found: 266.1321.



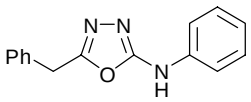
***N*-Benzyl-(5-*tert*-butyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (7): $^1$H NMR (400 MHz, dmso-$d_6$)** δ 11.99 (s (br), 1H) 10.18 (s, 1H) 7.46 (dd, *J* = 18.5, 7.5Hz, 2H) 7.32 (m, 3H) 4.56 (s, 2H) 1.28 (s, 9 H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 159.8, 136.9, 128.5, 127.9, 127.6, 46.2, 31.9, 27.2. **HPLC** Retention time: 6.63 min. **m.p.** 185.7 – 186.8 °C. **IR** 2970.9 (s) 1718.6 (s) 1629.9 (s) 1456.2 (s) 1367.9 (s) 1238.4 (m) 1145.2 (s). HRMS Calcd $C_{13}H_{17}N_3O$: 232.1450. Found: 232.1447.

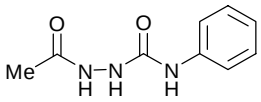


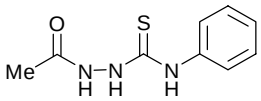
***N*-Phenyl-phenyl acetic acid semicarbazide: $^1$H NMR (400 MHz, dmso-$d_6$)** δ 9.95 (s, 1H) 8.72 (s, 1H) 8.08 (s, 1H) 7.43 (d, *J* = 8.0Hz, 2H) 7.31 (m, 5H) 7.24 (t, *J* = 7.6Hz, 2H) 6.94 (t, *J* = 7.6Hz, 1H) 3.49 (s, 2H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 170.1 155.3 139.6 135.7 129.1 128.7 128.2 126.5 121.9 118.4. **HPLC** Retention time: 4.34 min. **m.p.** 210.0 – 211.3 °C. **IR** 3276.2 (s) 3037.6 (s) 1651.3 (s) 1598.0 (s) 1562.0 (s) 1495.8 (s) 1453.9 (m) 1312.7 (m) 1236.5 (m) 1117.1 (m). HRMS Calcd $C_{15}H_{15}N_3O_2$: 270.1243. Found: 270.1244.

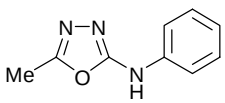


***N*-Phenyl-phenyl acetic acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-$d_6$)** δ 10.16 (s, 1H) 9.66 (s (br), 1H) 9.60 (s, 1H) 7.43 (d, *J* = 7.6Hz, 2H) 7.31 (m, 6H) 7.24 (m, 1H) 7.16 (t, *J* = 7.2Hz, 1H) 3.52 (s, 2H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 170.1 139.1 135.5 129.3 128.2 126.5. **HPLC** Retention time: 5.53 min. **m.p.** 160.4 – 162.2 °C. **IR** 3302.2 (s) 3224.0 (s) 3059.8 (w) 1700.5 (m) 1663.1 (s) 1627.9 (m) 1540.2(s) 1499.0 (s) 1361.5 (s) 1226.9 (w) 1161.2 (w). HRMS Calcd $C_{15}H_{15}N_3OS$: 286.1014. Found: 286.1010.

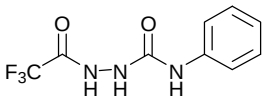
***N*-Phenyl-(5-benzyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (8): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.37  (s, 1H) 7.51 (d, *J* = 8.0Hz, 2H) 7.33 (m, 7H) 6.96 (t, *J* = 7.4Hz, 1H) 4.16 (s, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 160.0 158.7 138.7 134.9 129.0 128.8 128.7 127.1 121.6 116.8 30.7. **HPLC** Retention time: 8.19 min. **m.p.** 178.1 – 180.6 °C. **IR** 3029.6 (m) 2928.6 (s) 2396.1 (m) 1836.9 (m) 1672.0 (s) 1621.7 (s) 1595.0 (s) 1500.9 (s) 1455.6 (s) 1246.9 (w) 1106.1 (w) 1015.4 (s). HRMS Calcd $C_{15}H_{13}N_3O$: 252.1137. Found: 252.1130.

***N*-Phenyl acetic acid semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.62 (s, 1H) 8.69 (s, 1H)  7.95 (s, 1H) 7.42 (d, *J* = 7.6Hz, 2H) 7.24 (t, *J* = 8.0Hz, 2H) 6.94 (t, *J* = 7.6Hz, 1H) 1.86 (s, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 169.3 155.4 139.6 128.6 121.9 118.5 20.6. **HPLC** Retention time: 1.75 min. **m.p.** 170.2 – 171.4 °C. **IR** 3297.0 (s) 3041.7 (s) 1653.7 (s) 1560.2 (s) 1370.5 (s) 1234.2 (s) 1177.1 (m). HRMS Calcd $C_9H_{11}N_3O_2$: 194.0930. Found: 194.0929.

***N*-Phenyl acetic acid *thio*-semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.86 (s, 1H) 9.60 (s  (br), 1H) 9.51 (s, 1H) 7.42 (d, *J* = 8.0Hz, 2H) 7.32 (t, *J* = 8.0Hz, 2H) 7.15 (t, *J* = 7.2Hz, 1H) 1.88 (s, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 181.0 169.2 139.2 128.1 125.8 125.1 21.4. **HPLC** Retention time: 2.06 min. **m.p.** 175.9 – 176.7 °C. **IR** 3260.4 (s) 3031.5 (s) 1700.7 (s) 1589.9 (m) 1496.7 (s) 1366.2 (m) 1248.2 (s) 1121.0 (m) 1072.0 (m). HRMS Calcd $C_9H_{11}N_3OS$: 210.0701. Found: 210.0699.

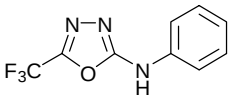
***N*-Phenyl-(5-methyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (9): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ  10.51 (br s, 1H) 7.54 (d, *J* = 8.0Hz, 2H) 7.30 (t, *J* = 7.6Hz, 2H) 6.96 (t, *J* = 7.2Hz, 1H) 2.37 (s, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 159.7 157.0 138.8 129.1 121.8 117.1 10.5. **HPLC** Retention time: 3.44 min. **m.p.** 160.0 – 162.9 °C. **IR** 3183.9 (s) 3048.7 (s) 1796.8 (m) 1675.8 (s) 1559.8 (s) 1387.3 (m) 1226.1 (m) 1012.4 (m). HRMS Calcd $C_9H_9N_3O$: 176.0824. Found: 176.0826.

***N*-Phenyl-trifluoromethyl acetic acid semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 8.76 (s, 1H) 7.95 (s, 1H) 7.47 (d, *J* = 8.0Hz, 2H) 7.24 (t, *J* = 8.0Hz, 2H) 6.95 (t, *J* = 7.6Hz, 1H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 156.0 139.7 128.6 121.8 118.5. **$^{19}$F NMR (375 MHz, dmso-*d*$_6$)** δ – 75.2.



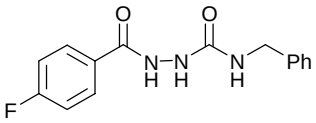
**HPLC** Retention time: 4.40 min. **m.p.** 265.8 – 266.6 °C. **IR** 3298.5 (s) 3093.9 (m) 1675.0 (s) 1558.4 (s) 1446.6 (s) 1337.9 (m) 1282.0 (m) 1173.9 (m).

***N*-Phenyl- trifluoromethyl acetic acid *thio*-semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.87 (s (br), 1H) 9.67 (s (br), 1H) 7.53 (d, *J* = 7.6Hz, 2H) 7.33 (t, *J* = 8.0Hz, 2H) 7.14 (t, *J* = 7.6Hz, 1H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 170.1 155.3 139.2 128.2 124.9. **$^{19}$F NMR (375 MHz, dmso-*d*$_6$)** δ – 75.3. **HPLC** Retention time: 6.60 min. **m.p.** 196.7 – 196.9 °C. **IR** 3212.1 (s) 2009.6 (m) 1597.6 (m) 1546.9 (s) 1508.9 (s) 1451.9 (m) 1336.4 (m) 1243.9 (m) 1189.3 (s).



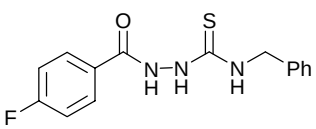
***N*-Phenyl-(5- trifluoromethyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (10): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 7.52 (d, *J* = 7.6Hz, 2H) 7.34 (t, *J* = 7.6Hz, 2H) 7.03 (t, *J* = 7.6Hz, 1H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 156.4 140.1 129.3 128.2 125.5 122.6 118.2. **$^{19}$F NMR (375 MHz, dmso-*d*$_6$)** δ – 62.7. **HPLC** Retention time: 7.57 min. **m.p.** 125.7 – 128.5 °C. **IR** 3392.9 (m) 3183.0 (s) 2920.7 (s) 1603.9 (s) 1560.2 (s) 1496.9 (s) 1370.8 (m) 1260.0 (m) 1189.8 (s) 1123.2 (m) 1035.1 (m).

***N*-Benzyl-4-fluoro-benzoic acid semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.21 (s, 1H)



7.97 (m, 3H) 7.26 (m, 8H) 4.24 (d, *J* = 6.0Hz, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 165.4 162.9 158.5 140.6 130.3 (d, *J* = 8.9Hz ) 129.3 128.1 126.9 126.5 115.3 (d, *J* = 21.6Hz) 42.6. **$^{19}$F NMR (375 MHz, dmso-*d*$_6$)** δ – 110.2. **HPLC** Retention time: 4.43 min. **m.p.** 229.5 – 230.4 °C. **IR** 3304.6 (s) 3066.5 (m) 3031.3 (m) 2921.2 (w) 1652.7 (s) 1604.1 (s) 1501.0 (s) 1455.5 (m) 1340.4 (m) 1233.4 (s) 1162.5 (s). HRMS Calcd $C_{15}H_{14}FN_3O_2$: 288.1148. Found: 288.1147.

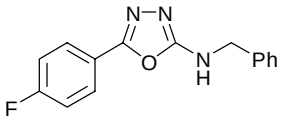
***N*-Benzyl-4-fluoro-benzoic acid *thio*-semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.44 (s,



1H) 9.45 (s, 1H) 8.67 (s, 1H) 7.98 (m, 2H) 7.33 (m, 7H) 4.73 (d, *J* = 6.0Hz, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 165.0 139.4 130.6 130.5 128.0 127.0 126.6 115.3 115.1 46.7. **$^{19}$F NMR (375 MHz, dmso-*d*$_6$)** δ –

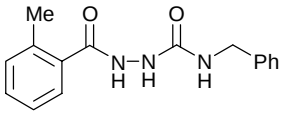
109.9. **HPLC** Retention time: 6.79 min. **m.p.** 171.9 – 173.9 °C. **IR** 3376.5 (m) 3219.7 (s) 2977.7 (m) 1680.8 (s) 1603.6 (s) 1540.9 (s) 1484.9 (s) 1454.0 (m) 1265.4 (m) 1164.6 (m) 1104.5 (w). HRMS Calcd $C_{15}H_{14}FN_3OS$: 304.0920. Found: 304.0918.

***N*-Benzyl-(5-(4-fluorophenyl)-[1,3,4]oxadiazol-2-yl)-amine (11): $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ



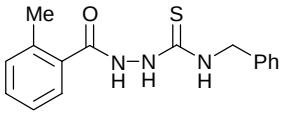
8.36 (t, *J* = 6.4Hz, 1H) 7.84 (dd, *J* = 5.2Hz, *J* = 8.8Hz, 2H) 7.35 (m, 5H) 7.26 (t, *J* = 7.0Hz, 1H) 4.44 (d, *J* = 6.4Hz, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 163.6 138.7 128.4 127.7 127.6 127.4 127.2 120.9 166.6 116.3 46.0. **$^{19}$F NMR (375 MHz, dmso-*d*$_6$)** δ – 111.2. **HPLC** Retention time: 8.65 min. **m.p.** 128.5 – 130.6 °C. **IR** 3232.1 (m) 3030.7 (m) 1715.2 (s) 1628.0 (s) 1502.8 (s) 1364.5 (w) 1231.1 (s) 1145.8 (m) 1033.2 (m). HRMS Calcd $C_{15}H_{12}FN_3O$: 270.1043. Found: 270.1041.

***N*-Benzyl-2-methyl-benzoic acid semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.82 (s, 1H)



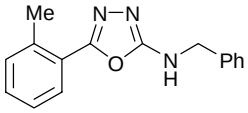
8.00 (s, 1H) 7.46 (d, *J* = 7.2Hz, 1H) 7.30 (m, 8H) 6.93 (br, 1H) 4.27 (d, *J* = 6.0Hz, 2H) 2.37 (s, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 169.0 158.3 140.6 136.1 130.5 129.8 128.1 127.6 126.9 126.5 125.3 42.7 19.4. **HPLC** Retention time: 4.60 min. **m.p.** 186.9 – 188.2 °C. **IR** 3369.5 (s) 3309.5 (s) 3214.1 (s) 3009.5 (s) 2935.5 (m) 1707.2 (s) 1635.2 (s) 1540.3 (s) 1428.7 (s) 1361.2 (w) 1265.8 (s) 1238.2 (s) 1131.5 (m) 1052.4 (m). HRMS Calcd $C_{16}H_{17}N_3O_2$: 284.1399. Found: 284.1394.

***N*-Benzyl-2-methyl-benzoic acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.01 (s,



1H) 9.46 (s, 1H) 8.50 (s (br), 1H) 7.63 (d, *J* = 7.2Hz, 1H) 7.30 (m, 8H) 4.76 (d, *J* = 5.6Hz, 2H) 2.38 (s, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 168.6 130.6 130.1 128.0 127.0 126.6 125.3 46.8 19.7. **HPLC** Retention time: 7.23 min. **m.p.** 197.8 – 198.6 °C. **IR** 3366.0 (s) 3204.0 (s) 3028.4 (m) 2913.3 (w) 1670.1 (s) 1542.3 (s) 1451.2 (m) 1338.1 (w) 1264.9 (m) 1223.4 (s) 1154.8 (m) 1117.7 (m). HRMS Calcd $C_{16}H_{17}N_3OS$: 300.1171. Found: 300.1175.

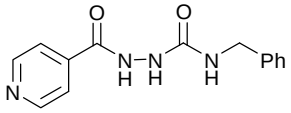
***N*-Benzyl-(5-(2-methylphenyl)-[1,3,4]oxadiazol-2-yl)-amine (12): $^1$H NMR (400 MHz, dmso-*d*$_6$)**



δ 8.32 (t, *J* = 6.0Hz, 1H) 7.69 (d, *J* = 7.6z, 1H) 7.35 (m, 7 H) 7.26 (t, *J* =

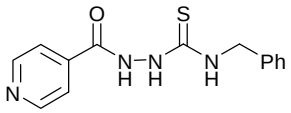
7.2Hz, 1H) 4.44 (d, *J* = 6.0Hz, 2H) 2.54 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 163.2 157.8 138.8 136.4 131.5 130.0 128.3 127.4 127.1 126.3 123.2 46.1 21.5. **HPLC** Retention time: 9.32 min. **m.p.** 162.4 – 164.4 °C. **IR** 3063.4 (w) 2896.7 (s) 1713.3 (s) 1614.2 (m) 1594.2 (w) 1455.8 (m) 1274.8 (m) 1036.2 (m). HRMS Calcd $C_{16}H_{15}N_3O$: 266.1293. Found: 266.1286.

***N*-Benzyl-*iso*-nictonic acid semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.48 (s, 1H) 8.74 (d,



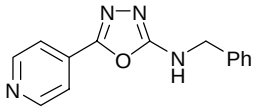
*J* = 4.4Hz, 2H) 8.12 (s, 1H) 7.80 (d, *J* = 4.8Hz, 2H) 7.28 (m, 5H) 7.20 (t, *J* = 6.8Hz, 1H) 4.24 (d, *J* = 6.0Hz, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 164.9 158.2 150.2 140.5 139.8 128.1 126.9 126.5 121.5 42.6. **HPLC** Retention time: 1.58 min. **m.p.** 215.7 – 217.6 °C. **IR** 3273.6 (s) 3084.7 (s) 2932.3 (s) 1652.8 (s) 1539.0 (s) 1408.2 (s) 1235.5 (s) 1064.2 (s). HRMS Calcd $C_{14}H_{14}N_4O_2$: 271.1184. Found: 271.1187.

***N*-Benzyl-*iso*-nictonic acid *thio*-semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.72 (s, 1H)



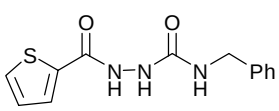
9.57 (s, 1H) 8.75 (d, *J* = 4.8Hz, 2H) 8.74 (s, 1H) 7.83 (d, *J* = 4.8Hz, 2H) 7.20 (m, 5H) 4.74 (d, *J* = 5.6Hz, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 164.5 150.2 139.6 139.2 128.1 127.0 126.7 121.7 46.8 40.1. **HPLC** Retention time: 2.58 min. **m.p.** 244.9 – 246.8 °C. **IR** 3276.2 (s) 2935.5 (s) 1675.0 (s) 1506.9 (s) 1324.8 (s) 1266.6 (s) 1061.6 (s) 1028.2 (s). HRMS Calcd $C_{14}H_{14}N_4OS$: 287.0967. Found: 287.0961.

***N*-Benzyl-(5-pyridin-4-yl-[1,3,4]oxadiazol-2-yl)-amine (13): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ



8.72 (dd, *J* = 1.6Hz, 4.4Hz, 2H) 8.61 (t, *J* = 6.0Hz, 1H) 7.71 (dd, *J* = 1.6Hz, 4.4Hz, 2H) 7.36 (m, 4H) 7.26 (t, *J* = 7.2Hz, 1H) 4.47 (d, *J* = 6.4Hz, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 164.2 156.1 150.7 138.5 131.0 128.4 127.4 127.2 118.8 46.0. **HPLC** Retention time: 2.36 min. **m.p.** 173.4 – 174.2 °C.**IR** 3227.2 (s) 3032.5(s) 1616.1 (s) 1577.3 (s) 1413.5 (s) 1273.0 (m) 1040.3 (s). HRMS Calcd $C_{14}H_{12}N_4O$: 253.1089. Found: 253.1090.

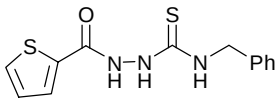
***N*-Benzyl-2-thiophenyl acid semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.19 (s, 1H) 8.03



(s, 1H) 7.82 (m, 2H) 7.22 (m, 6H) 7.09 (s (br), 1H) 4.23 (d, *J* = 6.0Hz, 2H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 161.5 158.4 140.6 137.7 131.4 128.9

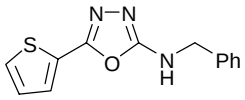
128.1 128.0 126.9 126.5 42.6. **HPLC** Retention time: 3.57 min. **m.p.** 184.5 – 186.0 °C. **IR** 3321.5 (s) 3030.8 (m) 1653.1 (s) 1566.1 (s) 1495.9 (s) 1356.3 (s) 1245.8 (s) 1059.4 (m). HRMS Calcd $C_{13}H_{13}N_3O_2S$: 276.0807. Found: 276.0801.

***N*-Benzyl-2-thiophenyl acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-$d_6$)** δ 10.4 (s, 1H)



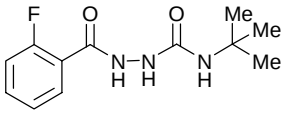
9.48 (s, 1H) 8.72 (s (br), 1H) 7.83 (d, *J* = 4.8Hz, 2H) 7.29 (m, 4H) 7.20 (m, 2H) 4.72 (d, *J* = 5.6Hz, 2H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 161.1 137.5 131.7 129.5 128.0 127.1 126.6 67.0 46.7 25.1 **HPLC** Retention time: 5.77 min. **m.p.** 202.5 – 203.8 °C. **IR** 3155.2 (s) 2974.6 (s) 1676.0 (s) 1558.3 (s) 1493.3 (s) 1353.6 (s) 1272.4 (s) 1235.8 (s) 1069.8 (s). HRMS Calcd $C_{13}H_{13}N_3OS_2$: 292.0578. Found: 292.0580.

***N*-Benzyl-(5-thiophen-2-yl-[1,3,4]oxadiazol-2-yl)-amine (14): $^1$H NMR (400 MHz, dmso-$d_6$)** δ



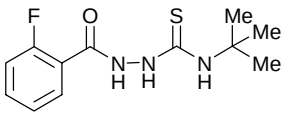
8.36 (t, *J* = 6.0Hz, 1H) 7.76 (d, *J* = 5.2Hz, 1H) (m, 1H) 7.35 (m, 4H) 7.26 (m, 1H) 7.20 (m, 1H) 4.42 (d, *J* = 6.0Hz, 2H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 163.1 154.1 138.6 129.2 128.3 127.5 127.4 127.1 125.4 46.1. **HPLC** Retention time: 7.22 min. **m.p.** *decomposed at 150 °C*. **IR** 3219.8 (s) 3026.9 (s) 1617.3 (s) 1454.6 (m) 1261.1 (m) 1011.8 (s). HRMS Calcd $C_{13}H_{11}N_3OS$: 258.0701. Found: 258.0702.

***N-tert*-Butyl-2-fluoro-benzoic acid semicarbazide: $^1$H NMR (400 MHz, dmso-$d_6$)** δ 9.88 (s, 1H)



7.74 (d, *J* = 2.4Hz, 1H) 7.61 (dt, *J* = 1.6Hz, *J* = 7.6Hz, 1H) 7.54 (m, 1H) 7.30 (m, 2H) 5.98 (s, 1H) 1.25 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 163.7 160.5 126.7 132.8 130.1 124.5 122.4 (d, *J* = 14.5Hz) 116.2 (d, *J* = 22.0Hz,) 49.5 29.0. **$^{19}$F NMR (375 MHz, dmso-$d_6$)** δ – 115.0. **HPLC** Retention time: 3.58 min. **m.p.** 178.3 – 179.9 °C. **IR** 3307.1 (s) 2968.0 (s) 1644.9 (s) 1572.1 (s) 1477.6 (s) 1365.0 (s) 1279.1 (s) 1094.7 (s). HRMS Calcd $C_{12}H_{16}FN_3O_2$: 254.1305. Found: 254.1307.

***N-tert*-Butyl-2-fluoro-benzoic acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-$d_6$)** δ 10.26 (s,



1H) 9.34 (s, 1H) 7.69 (t, *J* = 6.4Hz, 1H) 7.59 (m, 1H) 7.31 (m, 2H) 1.45 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-$d_6$)** δ 158.1 133.2 130.2 124.7 122.0 (d, *J* = 14.5Hz) 116.2 (d, *J* = 21.7Hz) 52.8 28.3. **$^{19}$F NMR (375 MHz, dmso-$d_6$)** δ – 115.1. **HPLC** Retention time: 6.52 min. **m.p.** 127.0 – 128.9 °C. **IR** 3328.4 (s) 3189.9 (s) 1645.4

(s) 1539.7 (s) 1362.7 (s) 1273.6 (s) 1096.1 (s). HRMS Calcd $C_{12}H_{16}FN_3OS$: 270.1076. Found: 270.1073.

***N-tert*-Butyl-(5-(2-fluorophenyl)-[1,3,4]oxadiazol-2-yl)-amine·HCl (15): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 7.83 (t, *J* = 6.8Hz, 1H) 7.71 (s, 1H) 7.55 (m, 1H) 7.37 (m, 2H) 1.36 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 162.4 159.8 157.2 132.5 (d, *J* = 8.4Hz) 128.4 125.1 (d, *J* = 3.3Hz) 116.9 (d, *J* = 20.7Hz) 112.5 (d, *J* = 12.0Hz) 51.1 28.3. **$^{19}$F NMR (375 MHz, dmso-*d*$_6$)** δ – 113.6. **HPLC** Retention time: 7.20 min. **m.p.** 171.8 – 173.9 °C. **IR** 3217.3 (m) 3097.3 (s) 2982.4 (s) 1700.0 (s) 1628.7 (s) 1577.7 (m) 1387.2 (s) 1234.6 (s) 1096.7 (s). HRMS Calcd $C_{12}H_{14}FN_3O$: 236.1199. Found: 236.1192.

***N-tert*-Butyl-2-methyl-benzoic acid semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.71 (s, 1H) 7.64 (s, 1H) 7.35 (m, 2H) 7.24 (m, 2H) 5.98 (s, 1H) 2.36 (s, 3H) 1.26 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 168.8 157.1 135.9 135.0 130.4 129.7 127.5 125.4 49.5 29.1 19.3. **HPLC** Retention time: 3.91 min. **m.p.** 188.1 – 189.8 °C. **IR** 3374.0 (s) 3275.1 (s) 2968.1 (s) 1700.2 (s) 1652.6 (s) 1558.0 (s) 1364.1 (s) 1271.3 (s) 1084.1 (s). HRMS Calcd $C_{13}H_{19}N_3O_2$: 250.1556. Found: 250.1561.

***N-tert*-Butyl-2-methyl-benzoic acid *thio*-semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.02 (s, 1H) 9.15 (s, 1H) 7.48 (d, *J* = 6.4Hz, 1H) 7.37 (t, *J* = 7.2Hz, 1H) 7.24 (m, 2H) 2.38 (s, 3H) 1.47 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 168.2 136.1 134.4 130.6 130.4 130.1 129.4 127.6 127.3 125.5 52.8 30.1 28.6 19.4. **HPLC** Retention time: 6.97 min. **m.p.** 135.4 – 137.4 °C. **IR** 3273.5 (s) 2965.6 (s) 1672.0 (s) 1525.6 (s) 1361.2 (s) 1268.6 (s) 1176.8 (m) 1077.4 (m). HRMS Calcd $C_{13}H_{19}N_3OS$: 266.1327. Found: 266.1332.

***N-tert*-Butyl-(5-(2-methylphenyl)-[1,3,4]oxadiazol-2-yl)-amine·HCl (16): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 7.69 (t, *J* = 7.2Hz, 1H) 7.68 (s, 1H) 7.35 (m, 3H) 2.57 (s, 3H) 1.37 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 161.8 157.3 136.4 131.5 129.9 127.3 126.2 123.3 51.0 28.3 21.6. **HPLC** Retention time: 8.65 min. **m.p.** 162.9

– 164.5 °C. **IR** 3224.2 (m) 3109.5 (s) 2979.1 (s) 1700.2 (s) 1615.0 (s) 1472.4 (s) 1277.0 (s) 1091.7 (s). HRMS Calcd $C_{13}H_{17}N_3O$: 232.1450. Found: 232.1453.

***N*-*tert*-Butyl-2-methoxy-benzoic acid semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.68 (d, *J* = 3.2Hz, 1H) 7.84 (d, *J* = 3.2Hz, 1H) 7.69 (dd, *J* = 1.2Hz, *J* = 7.6Hz, 1H) 7.48 (dt, *J* = 1.6Hz, *J* = 8.8Hz, 1H) 7.14 (d, *J* = 7.6Hz, 1H) 7.04 (t, *J* = 7.6Hz, 1H) 6.0 (s (br), 1H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 164.5 156.9 156.7 132.5 130.3 121.8 120.5 112.0 55.9 49.4 29.1. **HPLC** Retention time: 4.18 min. **m.p.** 140.6 – 142.0 °C. **IR** 3372.5 (s) 2975.6 (s) 1706.7 (s) 1632.7 (s) 1535.0 (s) 1436.8 (s) 1265.4 (s) 1017.4 (s). HRMS Calcd $C_{13}H_{19}N_3O_3$: 266.1505. Found: 266.1501.

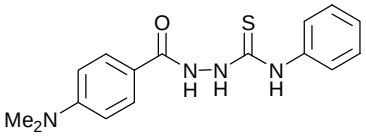
***N*-*tert*-Butyl-2-methoxy-benzoic acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.0 (s (br), 1H) 7.51 (s (br), 1H) 7.51 (t, *J* = 7.2Hz, 1H) 7.17 (d, *J* = 8.0Hz, 1H) 7.06 (t, *J* = 7.6Hz, 1H) 3.92 (d, *J* = 8.0Hz, 2H) 1.45 (s, 9H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 164.0 156.9 132.8 130.6 130.2 120.7 112.1 56.1 52.7 28.6. **HPLC** Retention time: 7.30 min. **m.p.** 141.0 – 142.5 °C. **IR** 3323.3 (s) 3187.5 (s) 2965.5 (s) 1640.9 (s) 1539.8 (s) 1433.3 (m) 1276.3 (s) 1162.4 (m) 1019.0 (s). HRMS Calcd $C_{13}H_{19}N_3O_2S$: 282.1176. Found: 282.1277.

***N*-*tert*-Butyl-(5-(2-methoxy-phenyl)-[1,3,4]oxadiazol-2-yl)-amine·HCl (17): $^1$H NMR (400 MHz, dmso-*d*$_6$):** δ 7.67 (d, *J* = 7.7Hz, 1 H) 7.52 (m, 1 H) 7.21 (d, *J* = 8.6Hz, 1 H) 7.08 (t, *J* = 7.5Hz, 1 H) 3.85 (s, 3 H) 1.37 (s, 9 H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$): δ** 160.4, 132.9, 129.5, 120.8, 112.6, 112.4, 56.0, 52.0, 28.3. **HPLC** Retention time: 6.58 min. **m.p.** 196.8 – 198.3 °C. **IR** 3060.6 (s) 2841.6 (s) 1684.5 (s) 1598.8 (s) 1487.3 (s) 1372.5 (s) 1269.7 (s) 1183.4 (s) 1075.9 (s). HRMS Calcd $C_{13}H_{17}N_3O_2$: 248.1399. Found: 248.1393.

***N*-Phenyl-4-dimethylamino-benzoic acid semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.92 (s, 1H) 8.80 (s, 1H) 8.00 (s, 1H) 7.78 (d, *J* = 8.8Hz, 2H) 7.46 (d, *J* = 8.0Hz, 2H) 7.24 (t, *J* = 8.0Hz, 2H) 6.94 (t, *J* = 7.6Hz, 1H) 6.71 (d, *J*

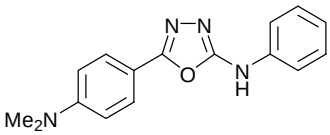
= 8.8Hz, 2H) 2.97 (s, 6H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 166.4 152.4 139.8 129.0 128.6 121.8 118.9 118.4 110.7. **HPLC** Retention time: 4.30 min. **m.p.** 250.8 – 251.9 °C. **IR** 3268.0 (s) 3040.5 (m) 2910.3 (m) 1653.0 (s) 1554.2 (s) 1374.9 (s) 1262.8 (m) 1136.5 (m) 1084.9 (m). HRMS Calcd $C_{16}H_{18}N_4O_2$: 299.1508. Found: 299.1501.

***N*-Phenyl-4-dimethylamino-benzoic acid *thio*-semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ



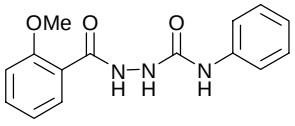
10.15 (s, 1H) 9.72 (br s, 1H) 9.57 (br s, 1H) 7.81 (d, *J* = 8.8Hz, 2H) 7.45 (br, 2H) 7.31 (t, *J* = 8.8Hz, 2H) 7.13 (t, *J* = 7.2Hz, 1H) 6.72 (d, *J* = 8.8Hz, 2H) 2.98 (s, 6H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 152.5 139.3 129.3 118.9 110.6. **HPLC** Retention time: 5.73 min. **m.p.** 243.0 – 244.8 °C. **IR** 3346.8 (s) 3244.5 (s) 1653.7 (s) 1601.4 (s) 1495.7 (s) 1376.4 (s) 1259.6 (s) 1172.4 (s) 1064.2 (m). HRMS Calcd $C_{16}H_{18}N_4OS$: 315.1280. Found: 315.1288.

***N*-*tert*-Butyl-(5-(4-dimethylamino-phenyl)-[1,3,4]oxadiazol-2-yl)-amine (18): $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ



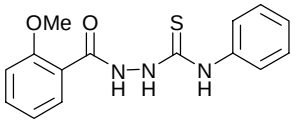
10.49 (s, 1 H) 7.69 (d, *J* = 8.4Hz, 2 H) 7.59 (d, *J* = 8.0 Hz, 2 H) 7.34 (t, *J* = 7.7Hz, 2 H) 6.98 (t, *J* = 7.3Hz, 1 H) 6.83 (d, *J* = 8.5Hz, 2 H) 2.99 (s, 6 H).**$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 158.6 151.7 129.0 126.8 121.6 116.8 111.9. **HPLC** Retention time: 9.09 min. **m.p.** 200.8 – 201.4 °C. **IR** 3304.3 (m) 2895.1 (m) 1612.2 (s) 1567.4 (s) 1450.6 (s) 1369.2 (s) 1236.2 (s) 1172.1 (s) 1067.2 (m). HRMS Calcd $C_{16}H_{16}N_4O$: 281.1402. Found: 281.1407.

***N*-Phenyl-2-methoxy-benzoic acid semicarbazide: $^1$H NMR (400 MHz, dmso-*d*$_6$)** δ 9.81 (s, 1H)



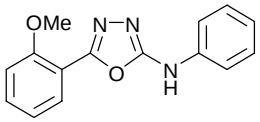
8.74 (br s, 1H) 8.30 (s, 1H) 7.77 (dt, *J* = 1.6Hz, *J* = 8.0Hz, 1H) 7.51 (dt, *J* = 1.6Hz, *J* = 8.0Hz, 1H) 7.45 (d, *J* = 7.6Hz, 2H) 7.25 (t, *J* = 8.0Hz, 2H) 7.17 (d, *J* = 8.0Hz, 1H) 7.06 (t, *J* = 7.6Hz, 1H) 6.95 (t, *J* = 7.6Hz, 1H) 3.90 (s, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 157.1 155.0 139.6 132.8 130.5 128.7 121.9 121.5 120.5 118.4 112.1 55.9. **HPLC** Retention time: 4.80 min. **m.p.** 234.3 – 234.9 °C. **IR** 3311.5 (s) 1717.1 (m) 1655.6 (s) 1563.2 (s) 1500.1 (m) 1318.3 (m) 1246.3 (s) 1165.7 (m). HRMS Calcd $C_{15}H_{15}N_3O_3$: 286.1192. Found: 286.1194.

***N*-Phenyl-2-methoxy-benzoic acid *thio*-semicarbazide: $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 11.00



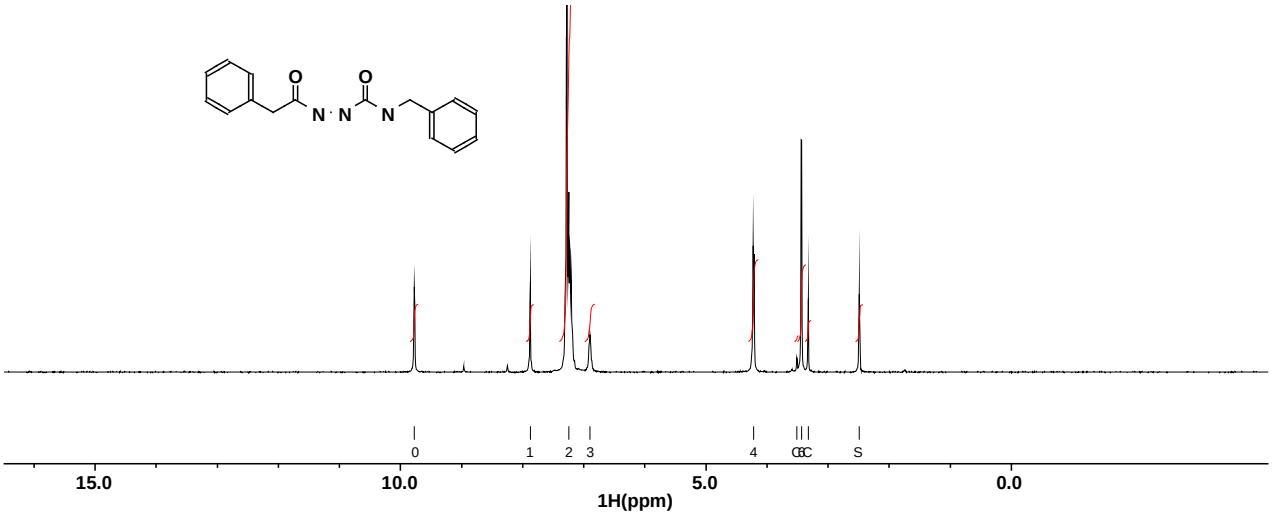

(br s, 1H) 10.00 – 9.55 (br, 2H) 7.89 (br s, 1H) 7.54 (m, 3H) 7.33 (t, *J* = 8.0Hz, 2H) 7.14 (m, 3H) 3.92 (s, 3H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 157.2 139.1 133.1 130.8 128.3 120.7 112.1 56.2. **HPLC** Retention time: 6.46 min. **m.p.** 192.8 – 195.2 °C. **IR** 3291.7 (s) 2943.1 (m) 1635.6 (s) 1599.5 (s) 1467.5 (s) 1356.4 (s) 1242.9 (s) 1161.4 (s) 1015.8 (s). HRMS Calcd $C_{15}H_{15}N_3O_2S$: 302.0963. Found: 302.0968.

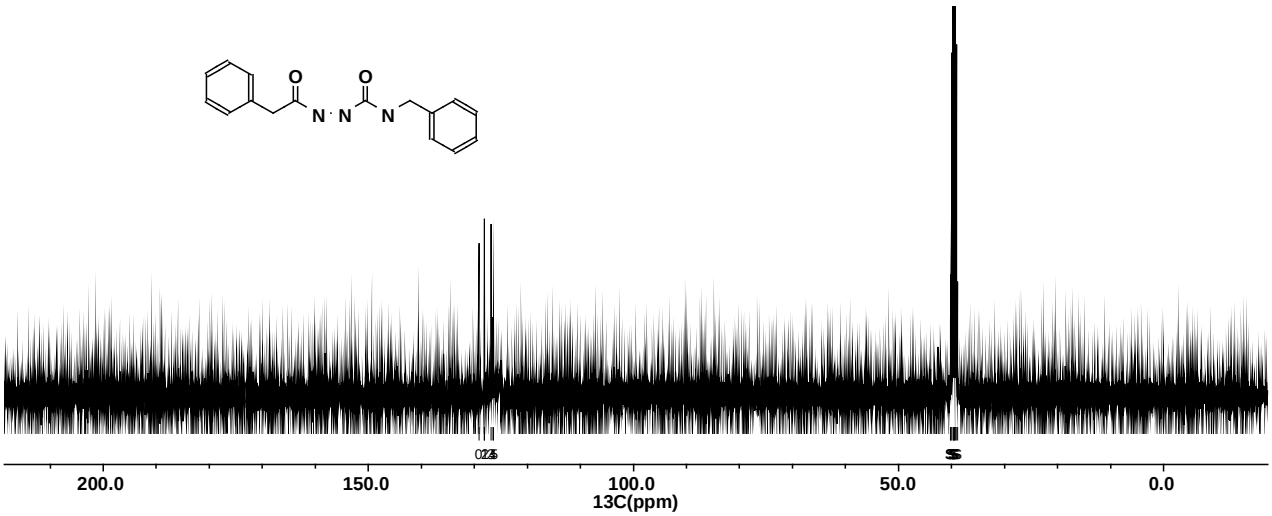
***N*-Phenyl-(5-(2-methoxy-phenyl)-[1,3,4]oxadiazol-2-yl)-amine·HCl (19): $^{1}$H NMR (400 MHz, dmso-*d*$_6$)** δ 10.72 (s, 1 H) 7.74 (d, *J* = 7.7Hz, 1 H) 7.62 (d, *J* = 8.0Hz, 2 H) 7.52 (m, 1 H) 7.34 (t, *J* = 7.7Hz, 2 H) 7.22 (d, *J* = 8.5Hz, 1 H) 7.09 (t, *J* = 7.6Hz, 1 H) 6.99 (t, *J* = 7.4Hz, 1 H) 3.88 (s, 3 H). **$^{13}$C NMR (100 MHz, dmso-*d*$_6$)** δ 160.0, 157.1, 138.8, 132.8, 129.8, 129.1, 121.9, 120.8, 117.1, 112.8, 112.6, 56.0. **HPLC** Retention time: 7.64 min. **m.p.** 195.7 – 196.6 °C. **IR** 3359.6 (m) 3042.4 (m) 1667.0 (s) 1571.6 (s) 1368.6 (m) 1279.3 (s) 1168.1 (s) 1075.4 (s). HRMS Calcd $C_{15}H_{13}N_3O_2$: 268.1086. Found: 268.1089.



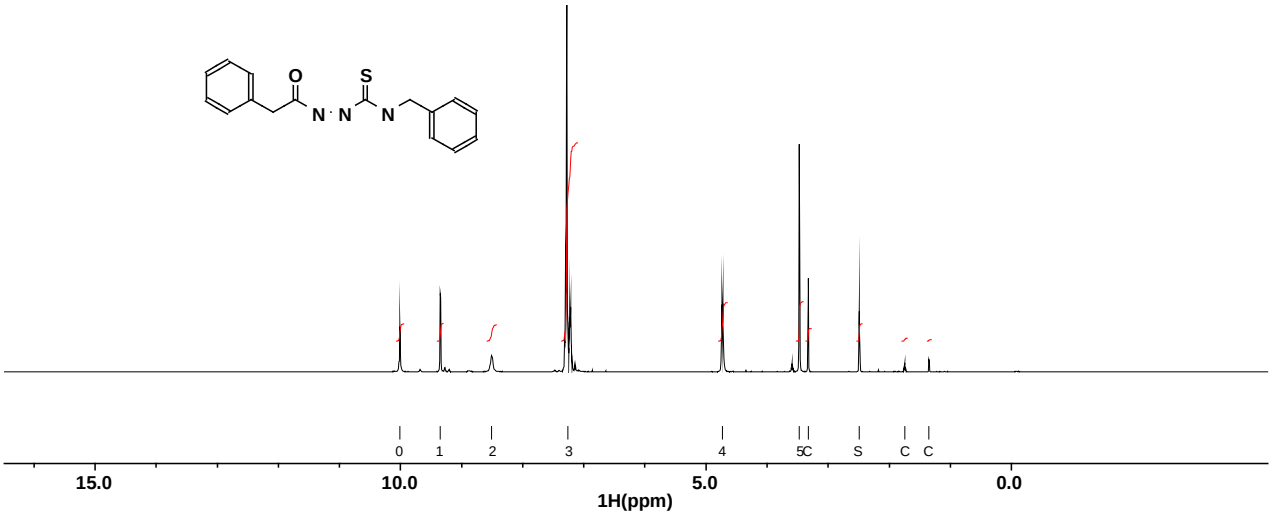
**Representative $^{1}H$ and $^{13}C$ Spectra:**

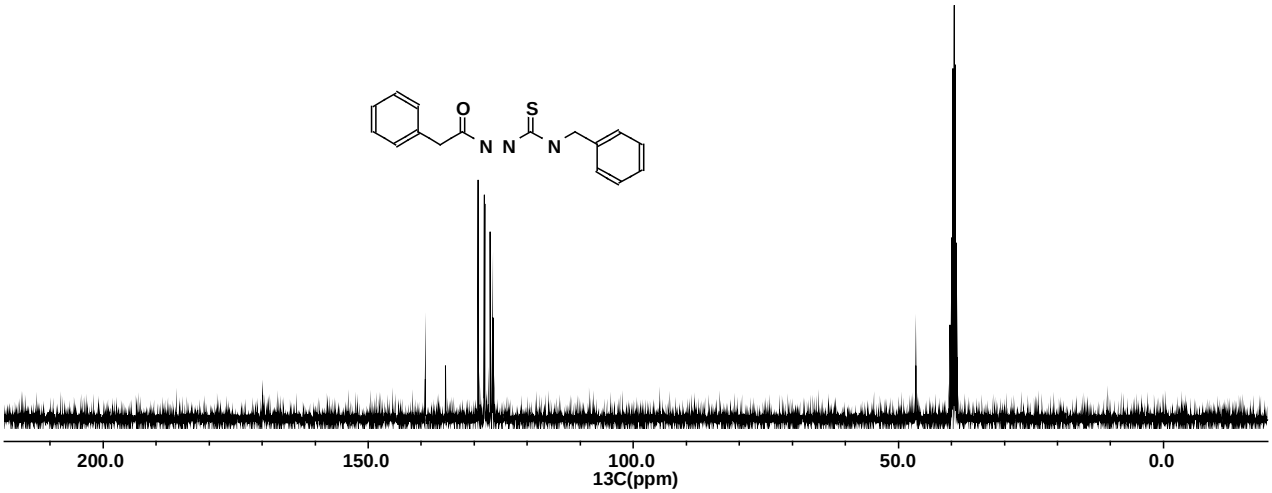
**N-Benzyl-phenyl acetic acid semicarbazide (1a)::**



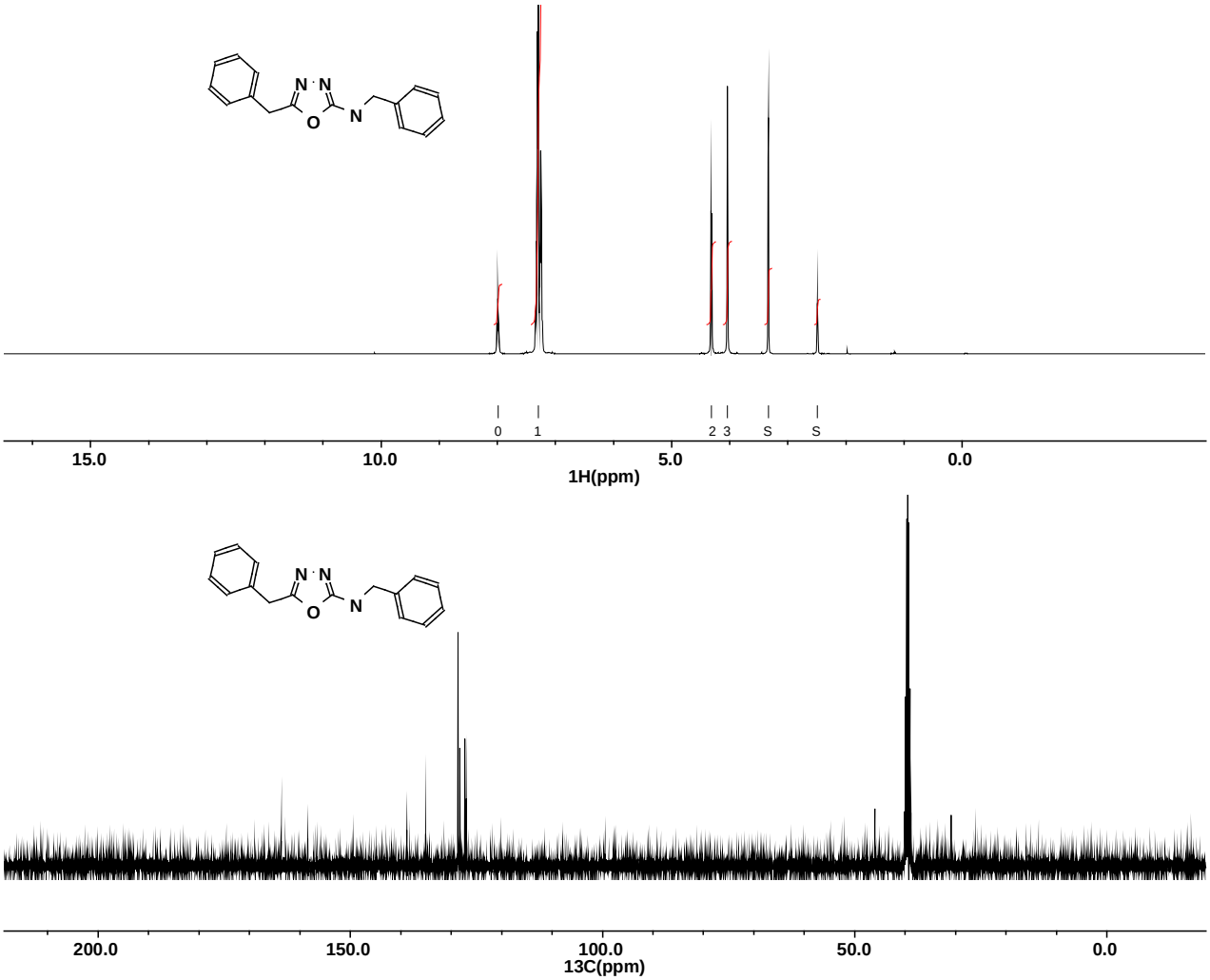



**N-Benzyl-phenyl acetic acid *thio*-semicarbazide (1b):**

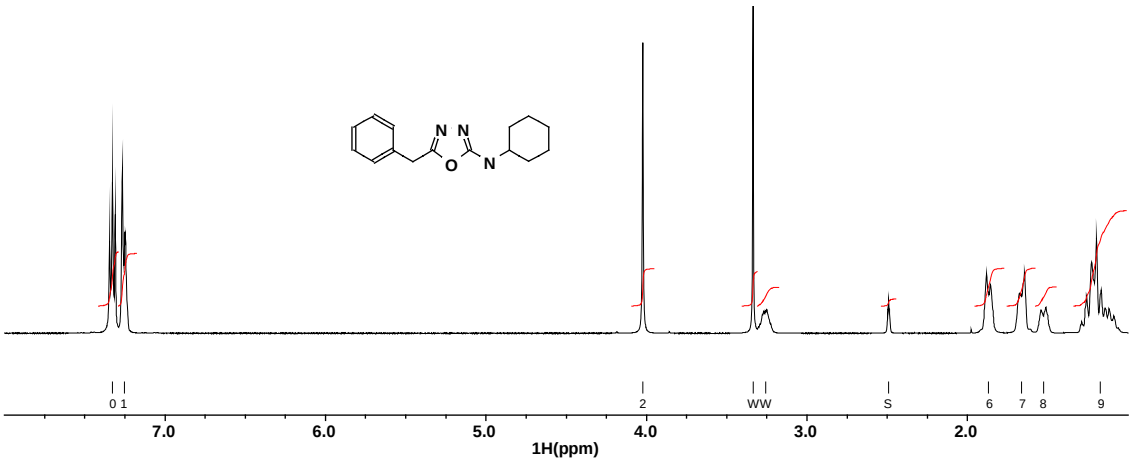


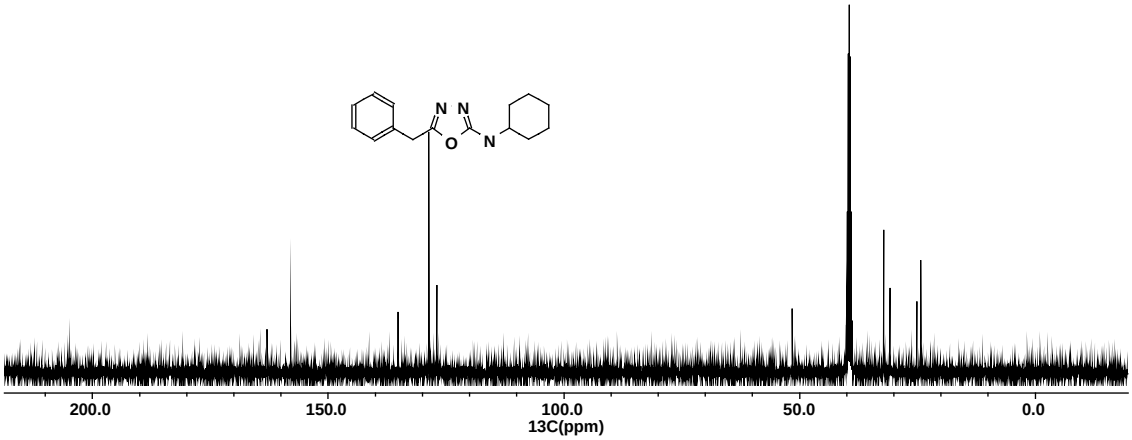



**Benzyl-(5-benzyl-[1,3,4]oxadiazol-2-yl)-amine (2):**

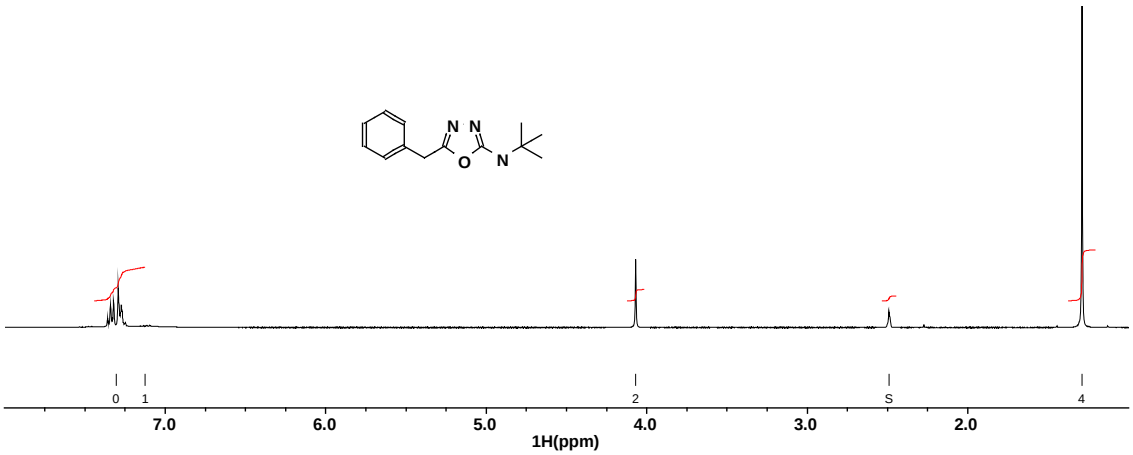


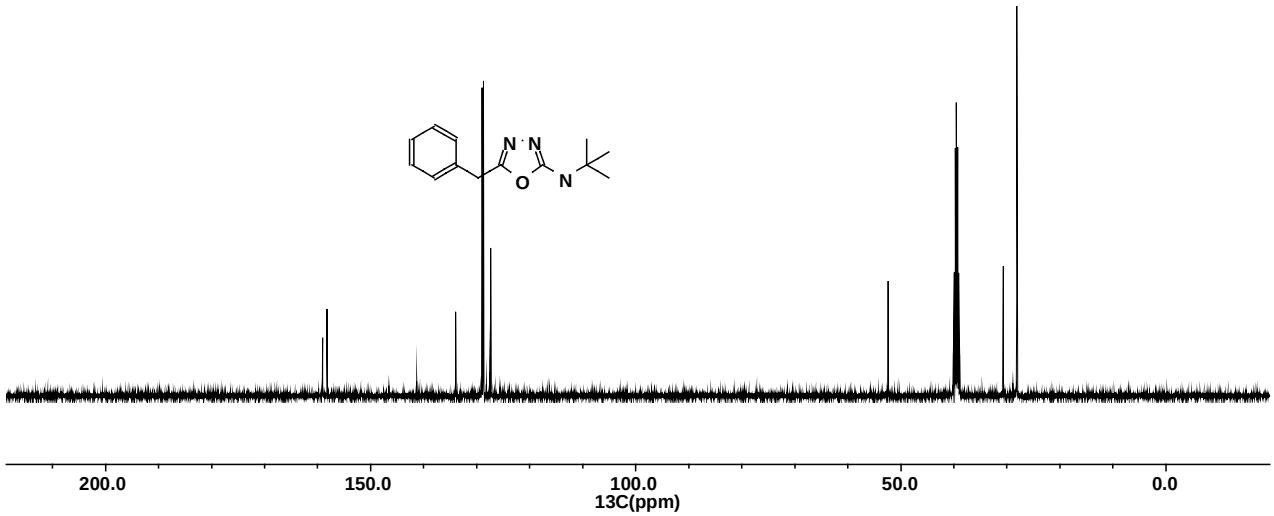
**Cyclohexyl-(5-benzyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (3):**



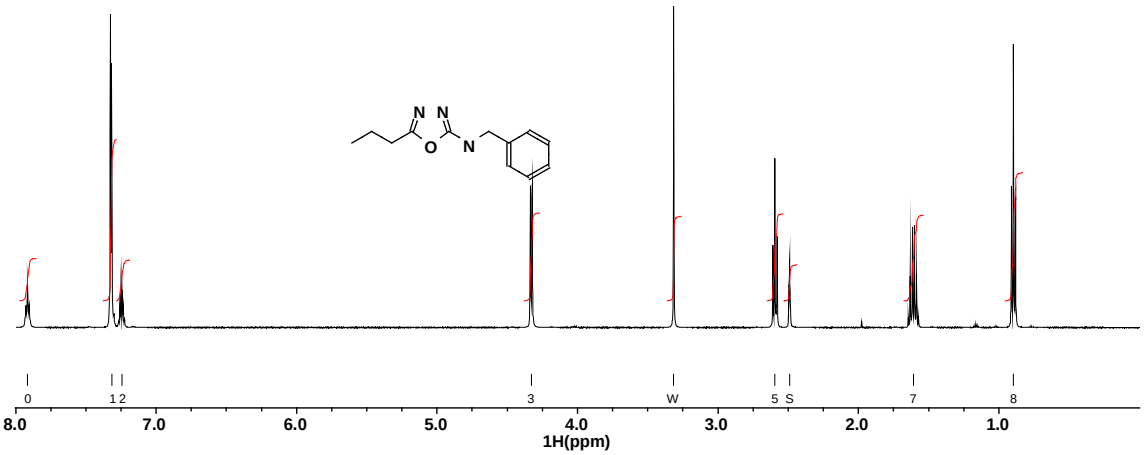



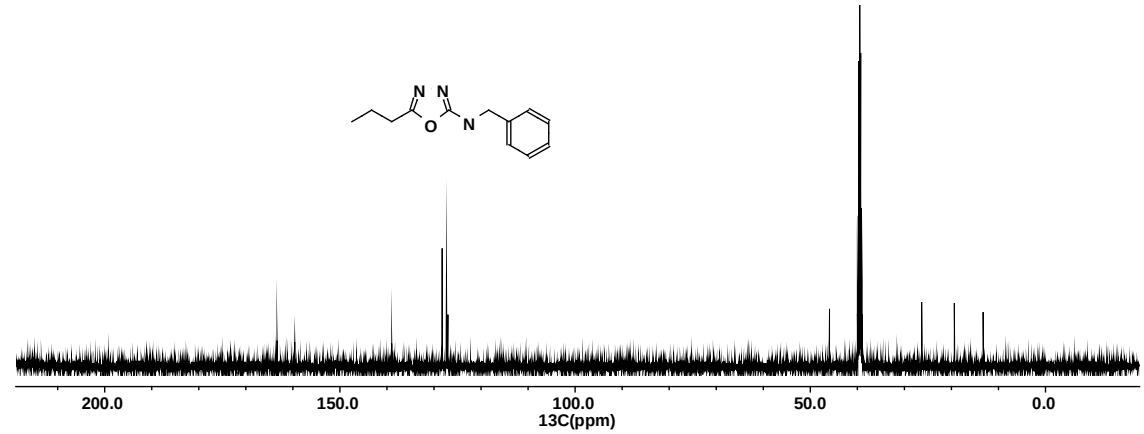
**N-*tert*-Butyl-(5-benzyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (4):**



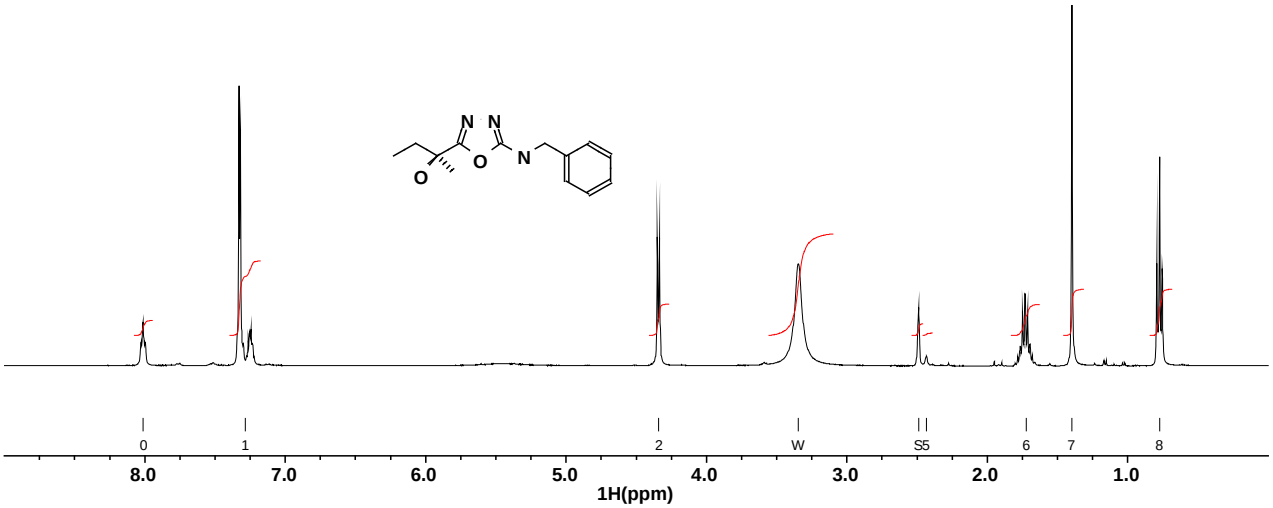



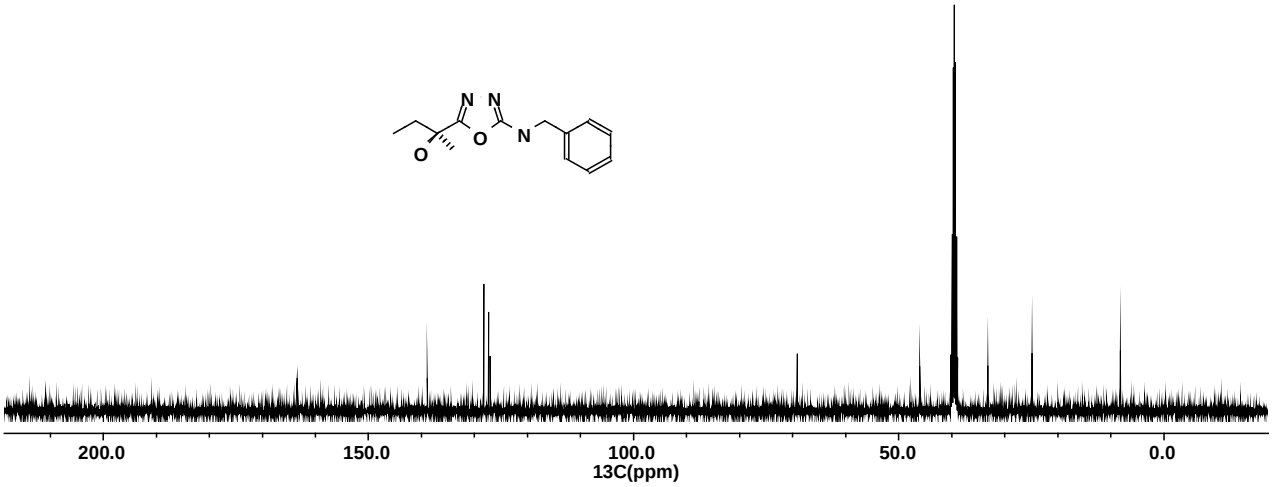
**N-Benzyl-(5-butyl-[1,3,4]oxadiazol-2-yl)-amine (5):**



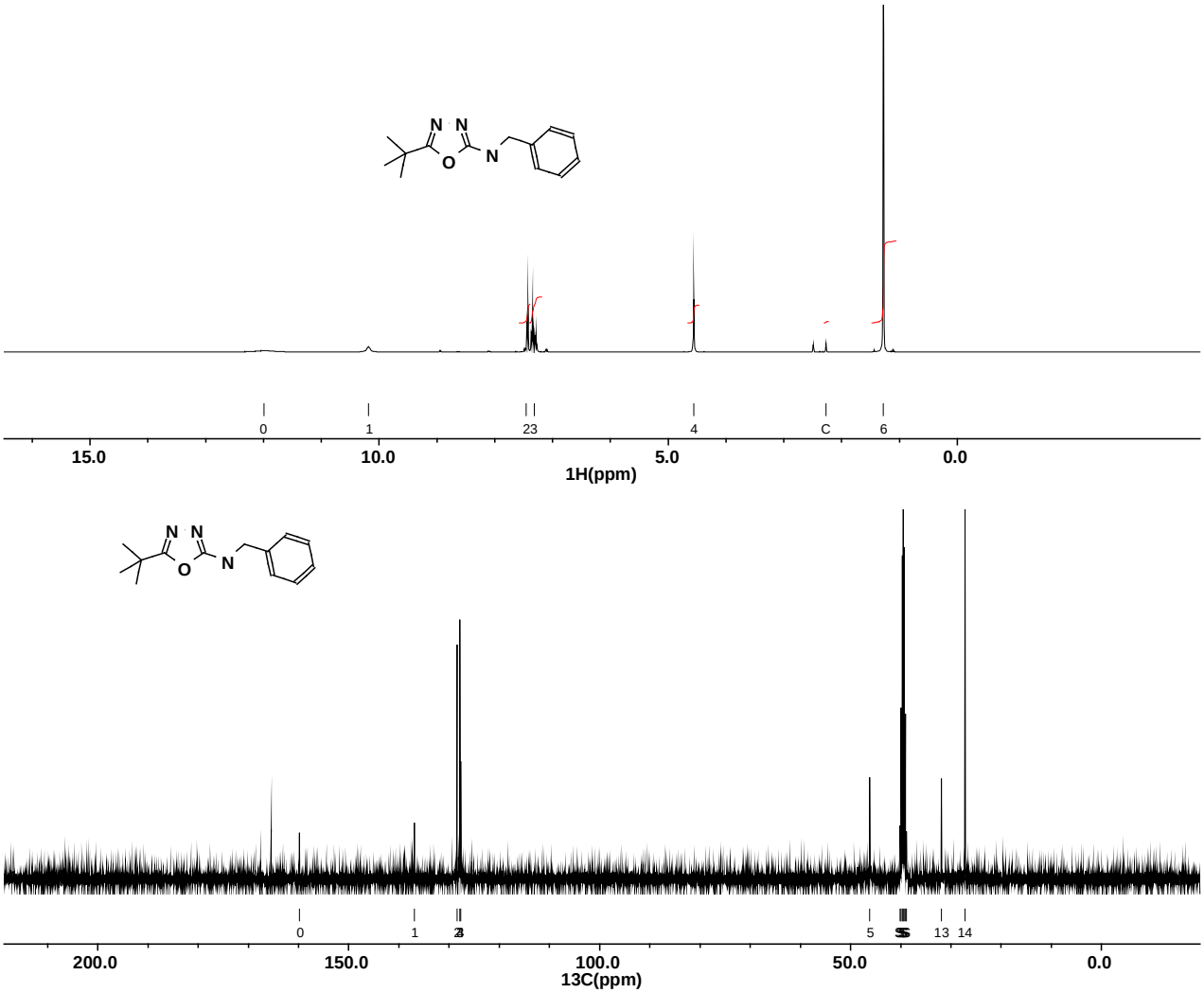



**N-Benzyl-(5-(2-hydroxy-2-methyl)-butyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (6):**

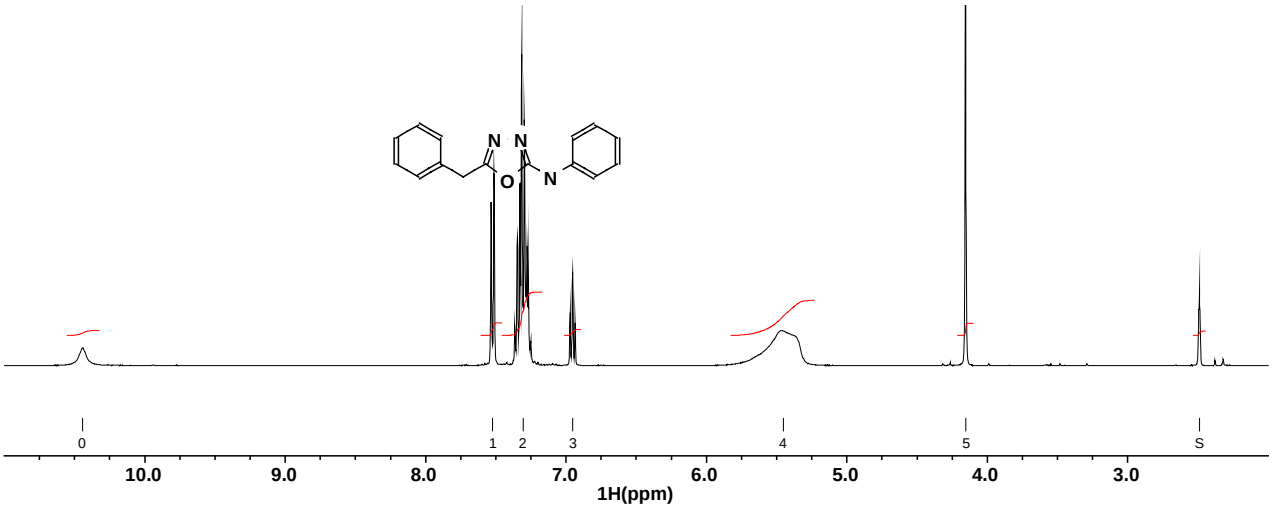


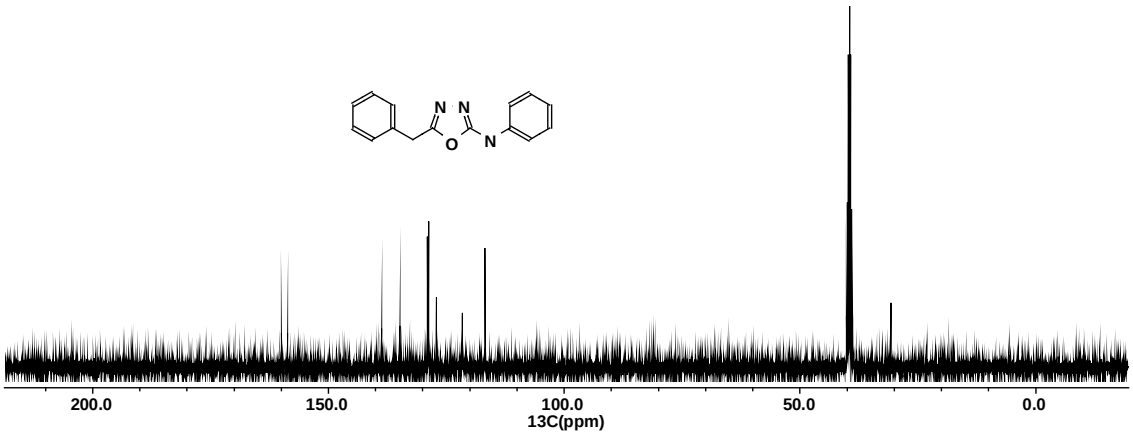



**N-Benzyl-(5-*tert*-butyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (7):**

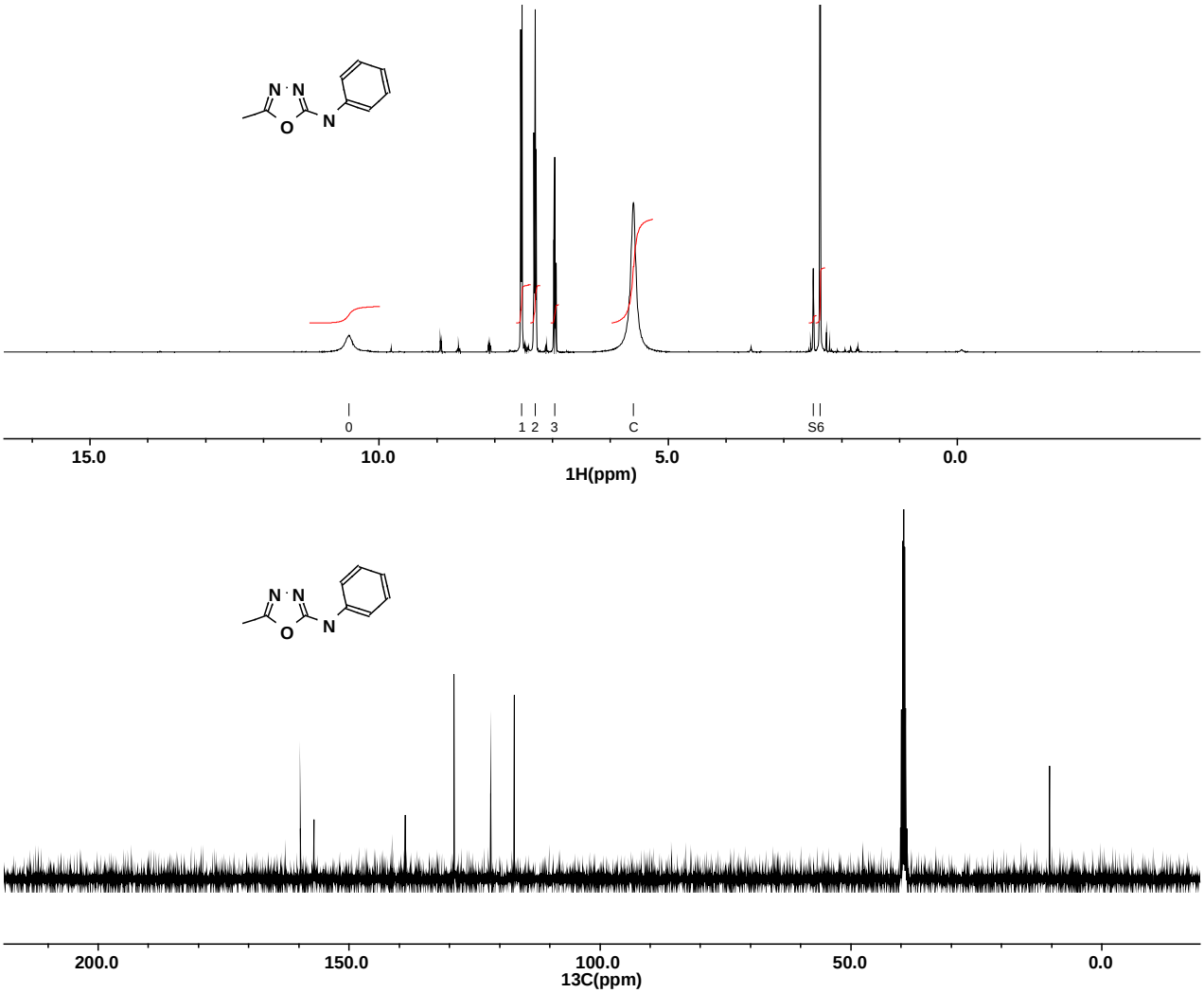


**N-Phenyl-(5-benzyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (8):**

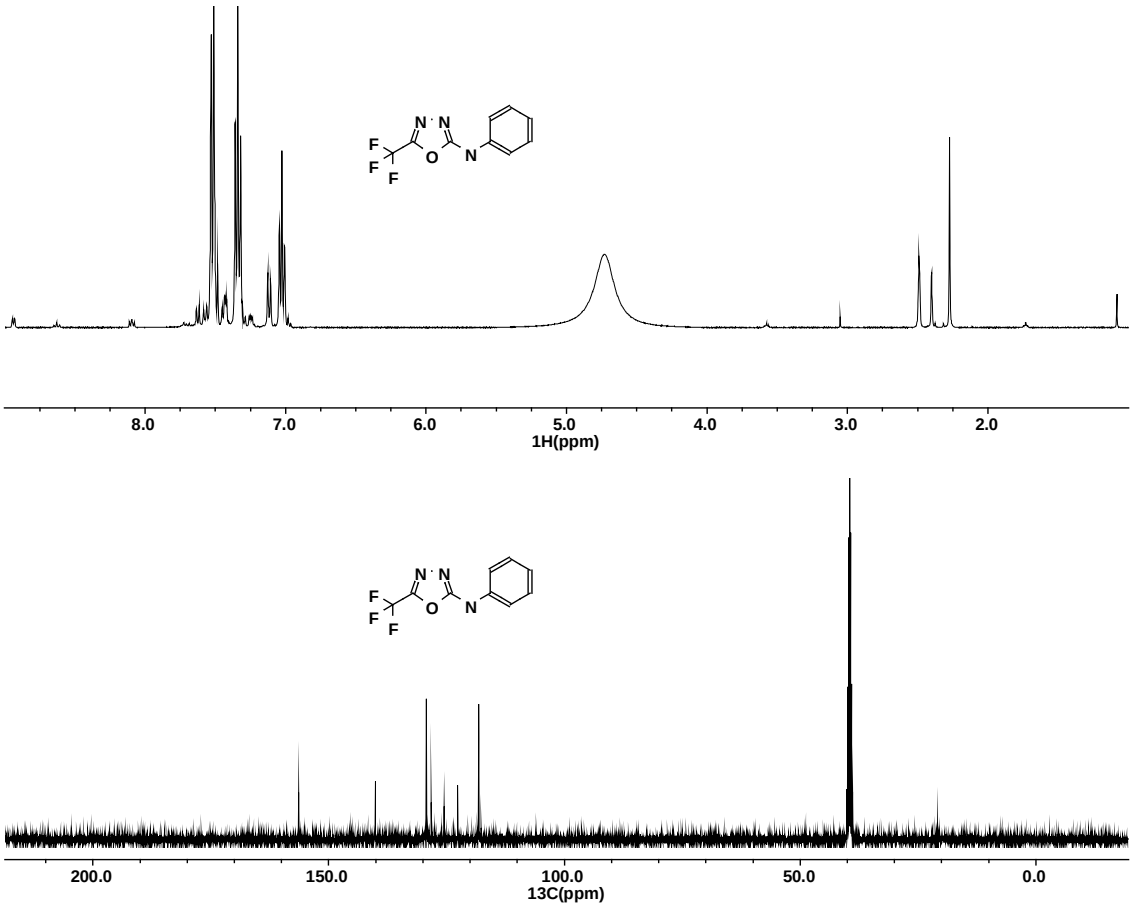


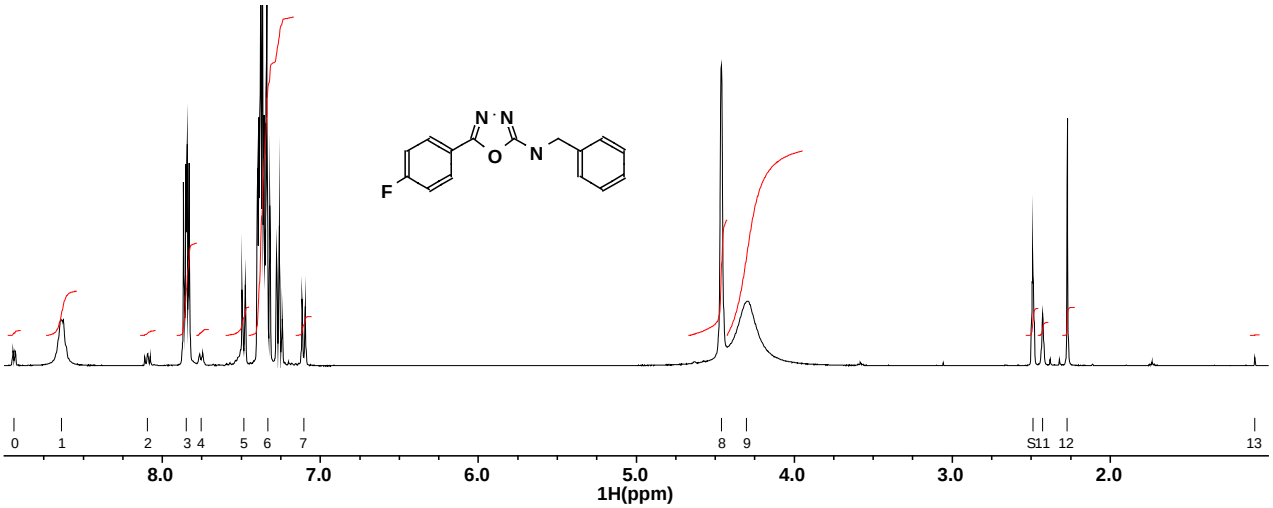
**N-Phenyl-(5-methyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (9):**

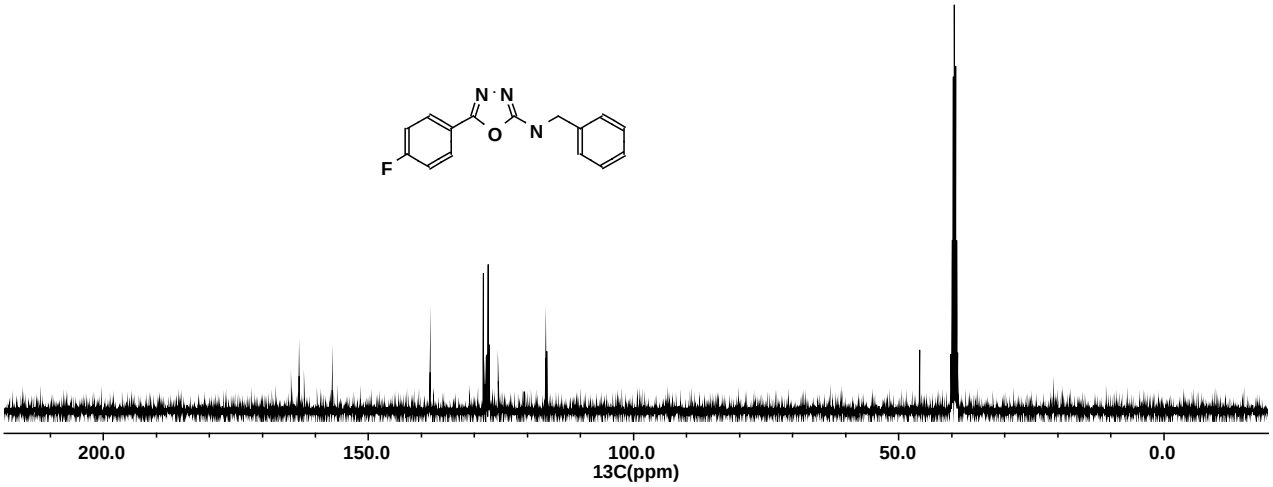


**N-Phenyl-(5- trifluoromethyl-[1,3,4]oxadiazol-2-yl)-amine·HCl (10):**

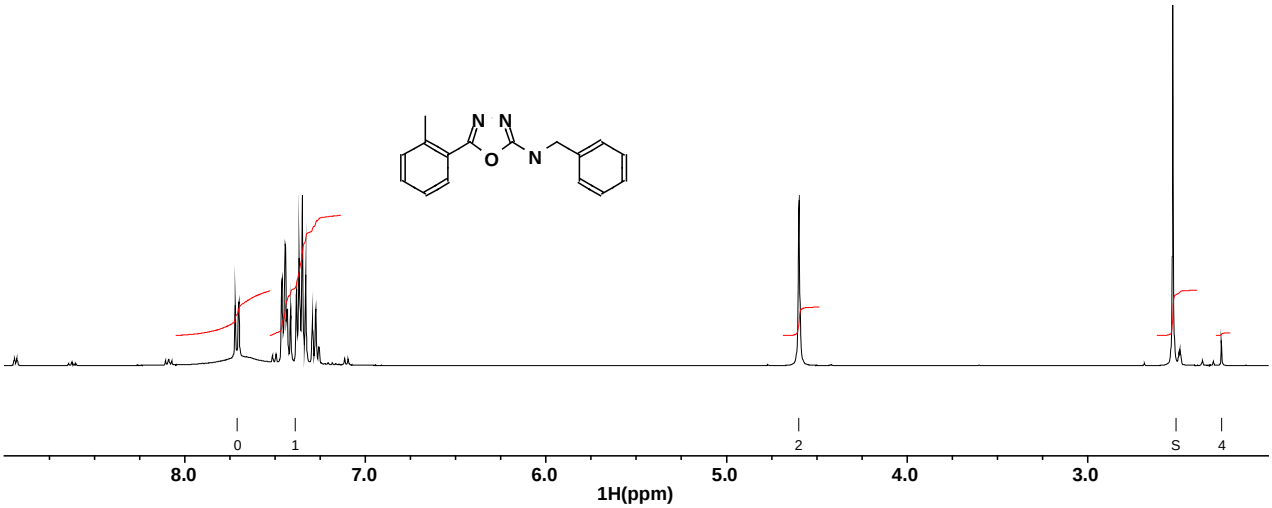


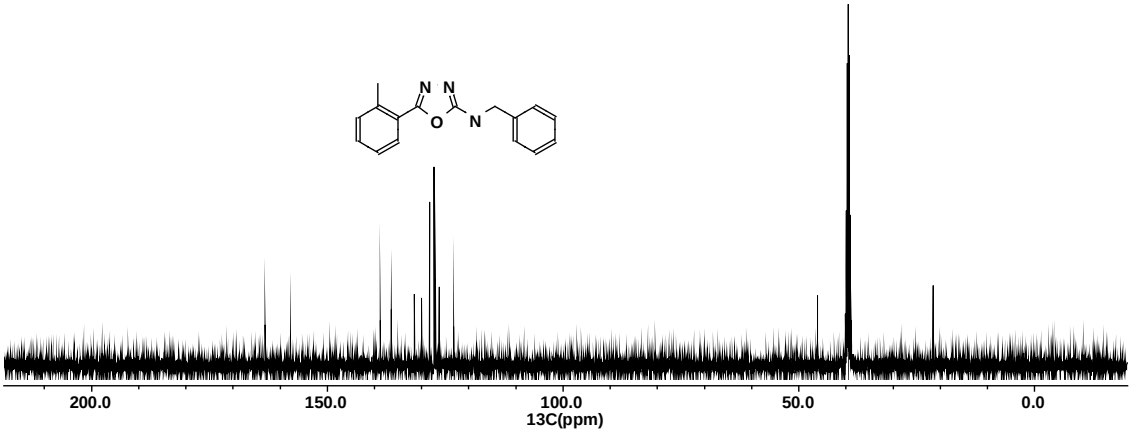
**N-Benzyl-(5-(4-fluorophenyl)-[1,3,4]oxadiazol-2-yl)-amine (11):**



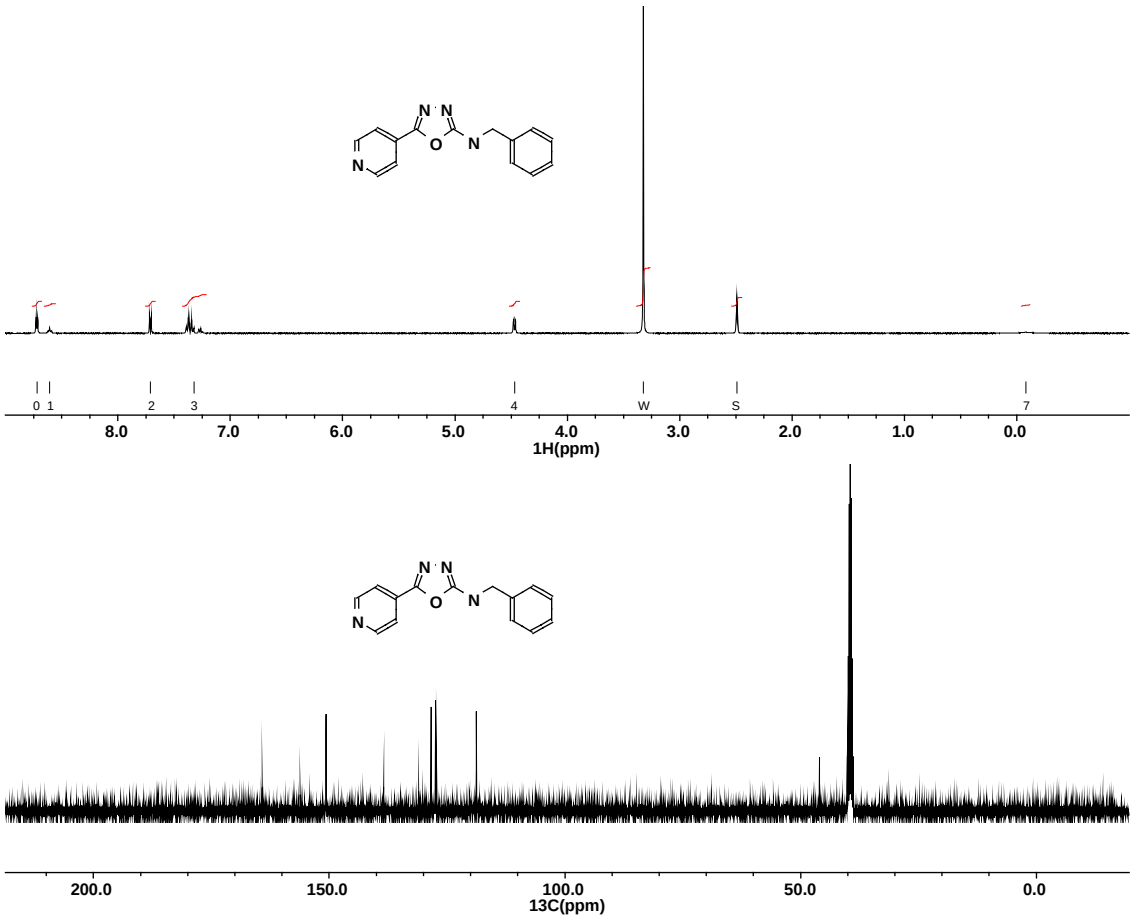



**N-Benzyl-(5-(2-methylphenyl)-[1,3,4]oxadiazol-2-yl)-amine (12):**

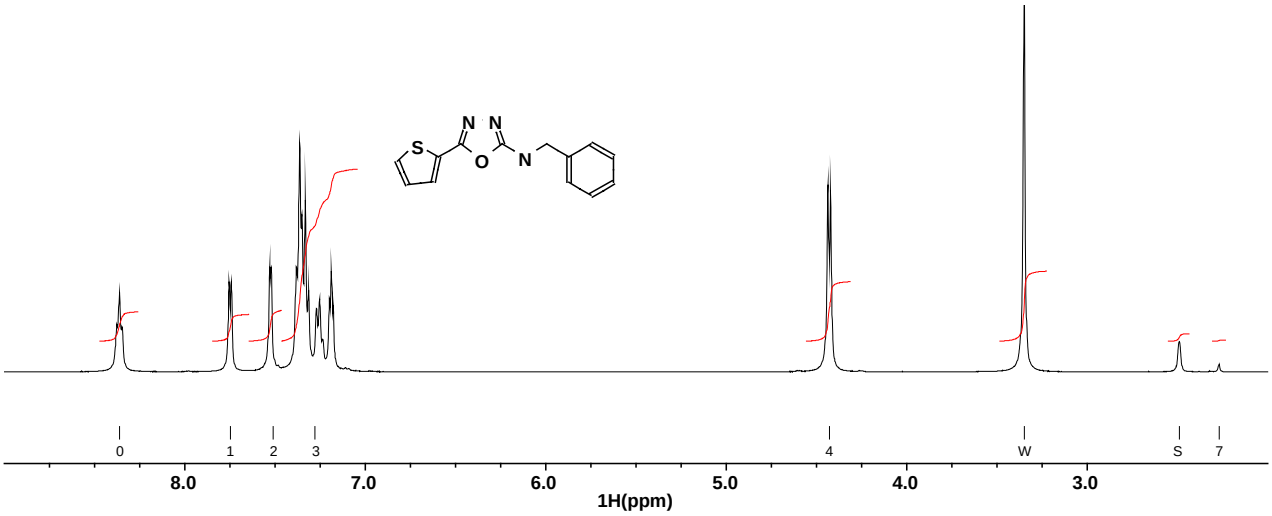


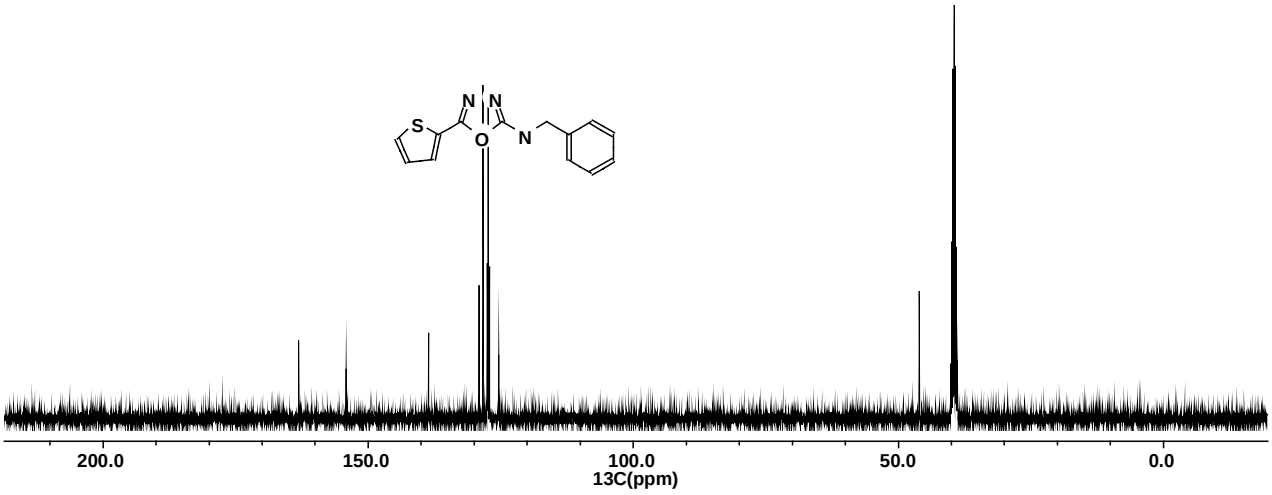



**N-Benzyl-(5-pyridin-4-yl-[1,3,4]oxadiazol-2-yl)-amine (13):**

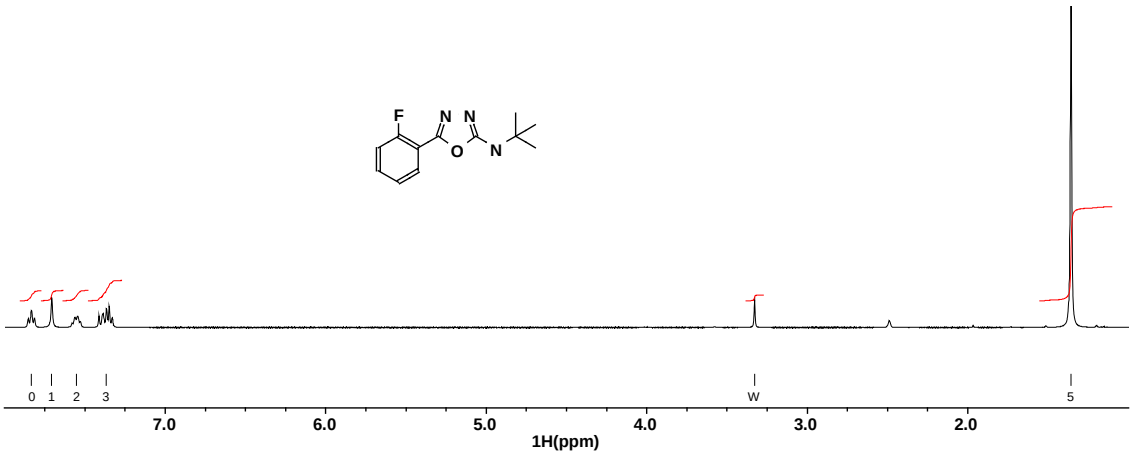


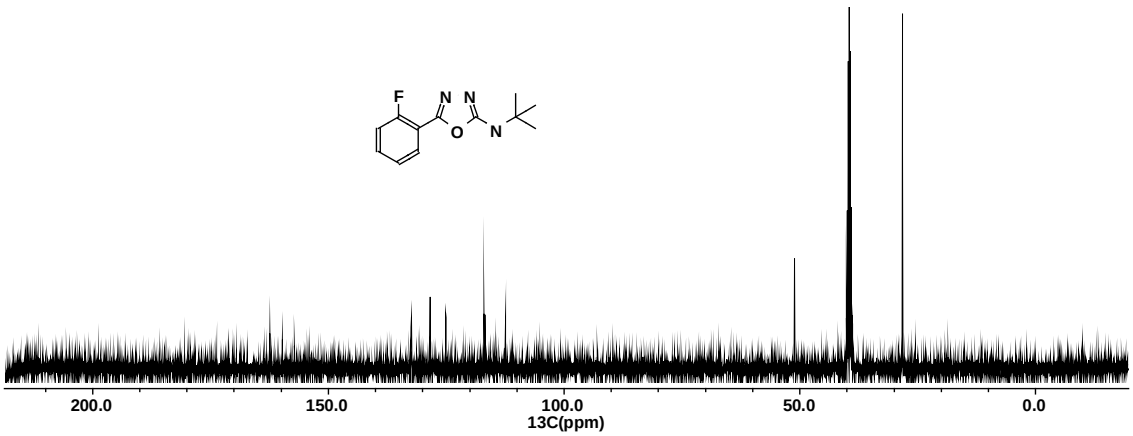
**N-Benzyl-(5-thiophen-2-yl-[1,3,4]oxadiazol-2-yl)-amine (14):**



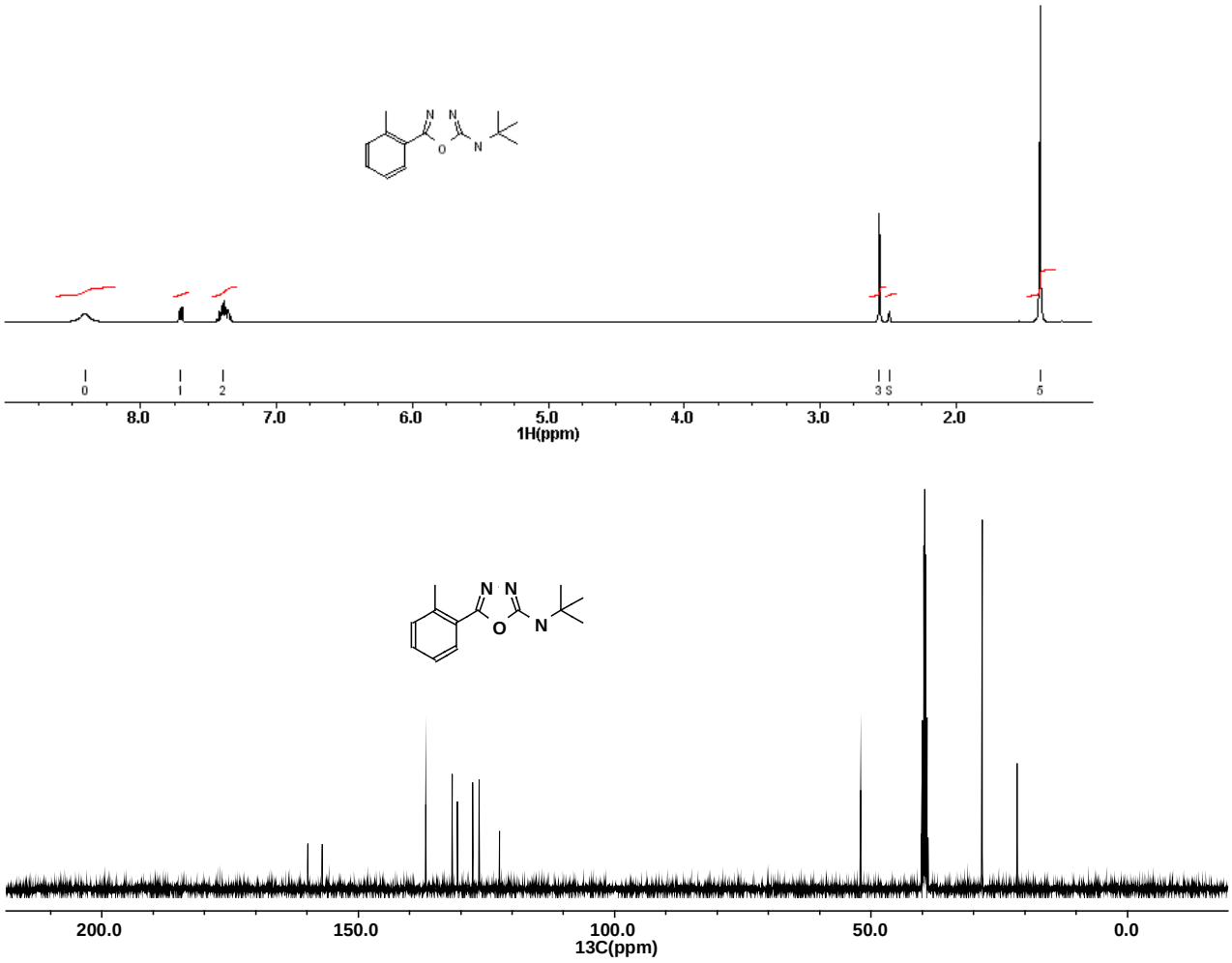



**N-*tert*-Butyl-(5-(2-fluorophenyl)-[1,3,4]oxadiazol-2-yl)-amine·HCl (15):**

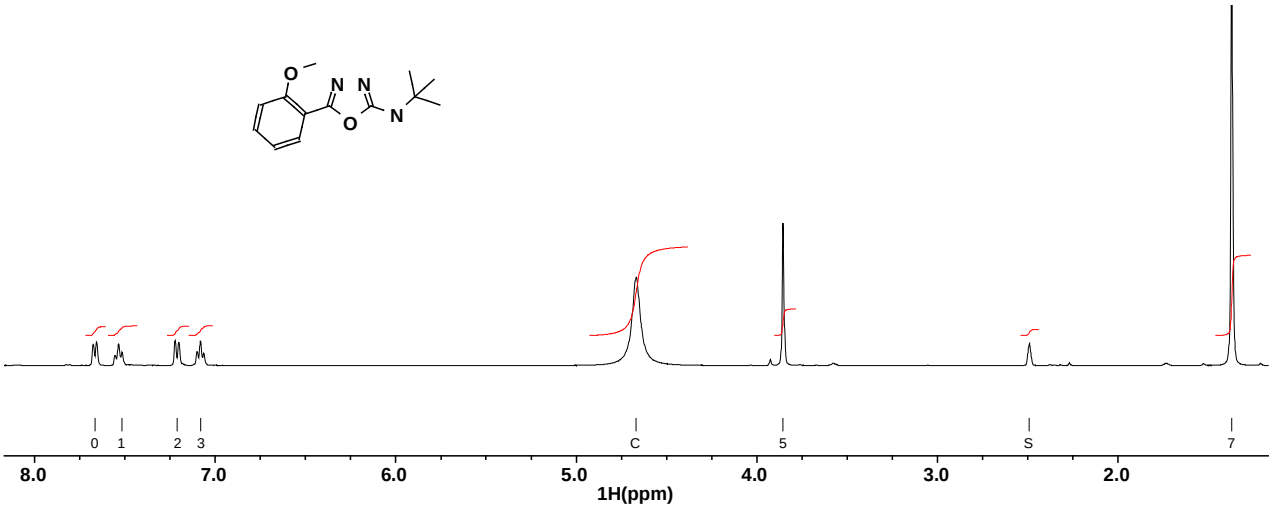


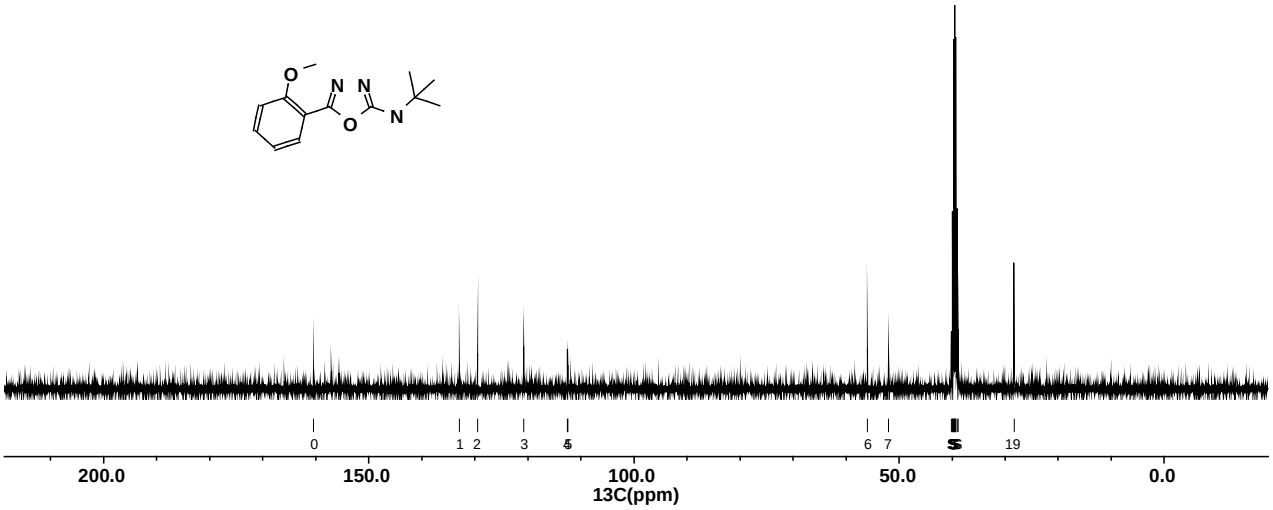



**N-*tert*-Butyl-(5-(2-methylphenyl)-[1,3,4]oxadiazol-2-yl)-amine·HCl (16):**

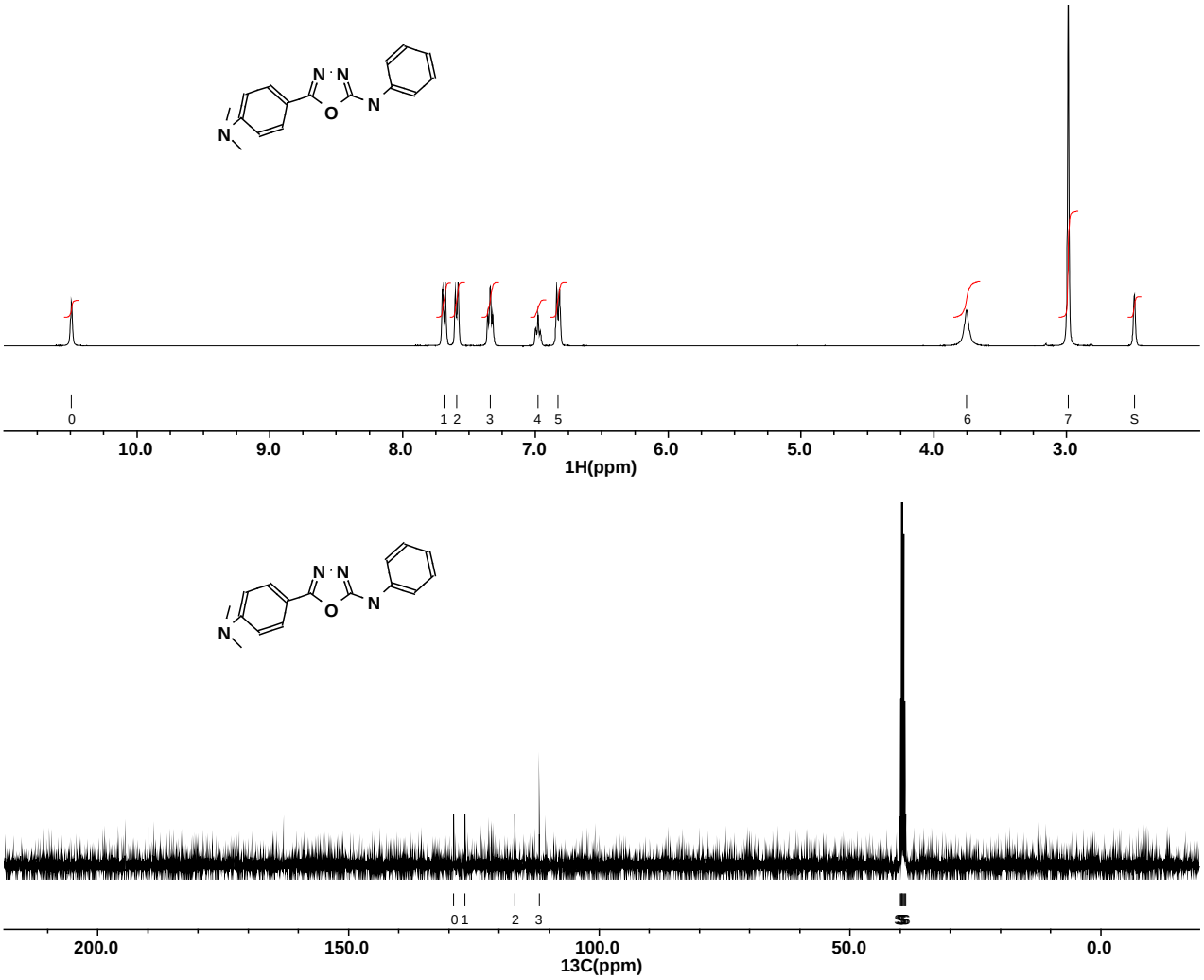


**N-*tert*-Butyl-(5-(2-methoxy-phenyl)-[1,3,4]oxadiazol-2-yl)-amine·HCl (17):**

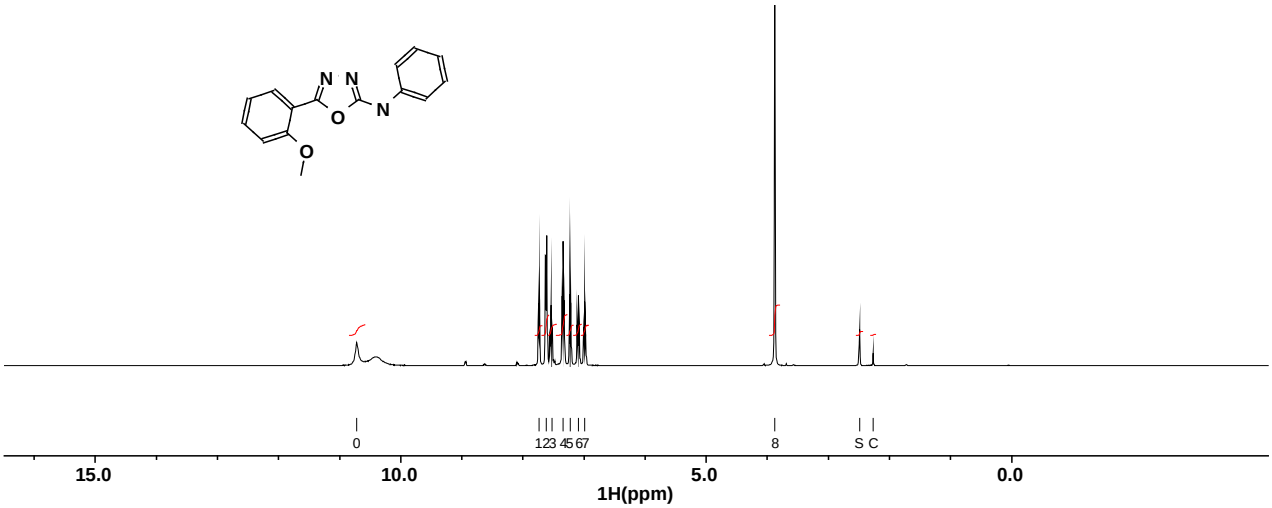


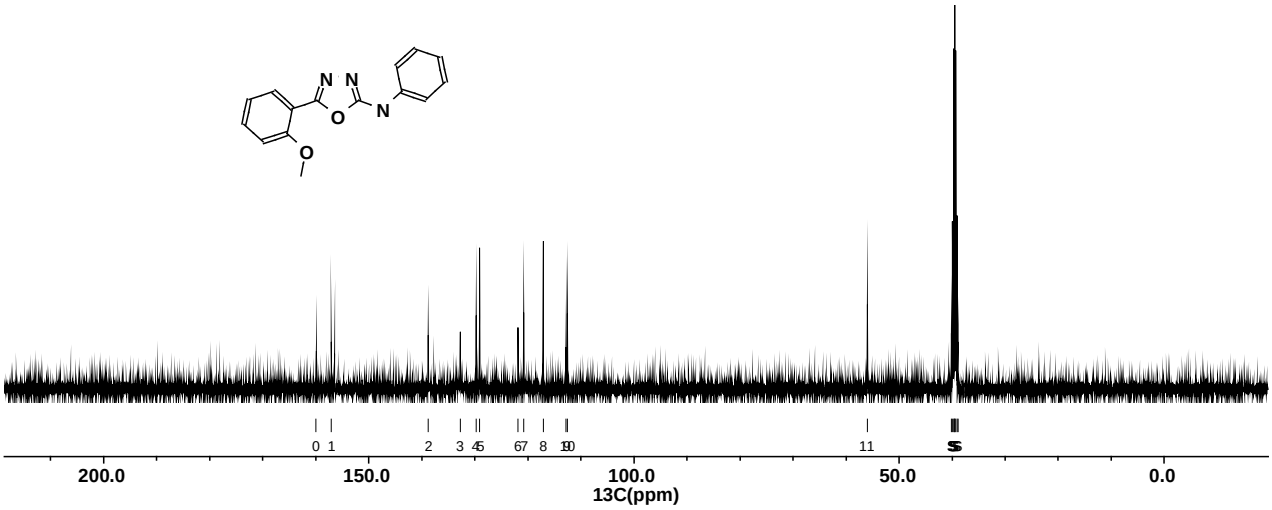



**N-*tert*-Butyl-(5-(4-dimethylamino-phenyl)-[1,3,4]oxadiazol-2-yl)-amine (18):**

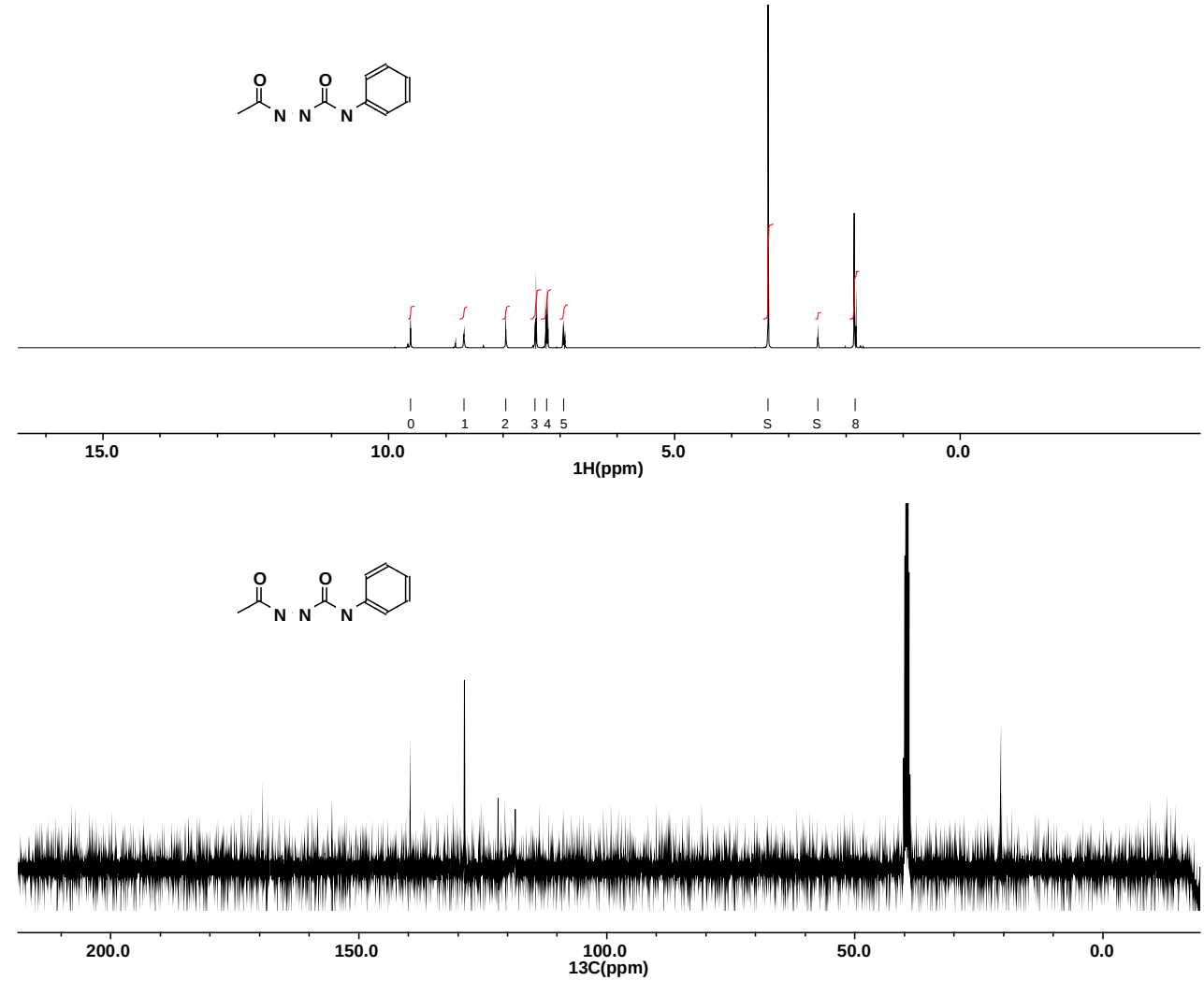


**N-Phenyl-(5-(2-methoxy-phenyl)-[1,3,4]oxadiazol-2-yl)-amine·HCl (19):**

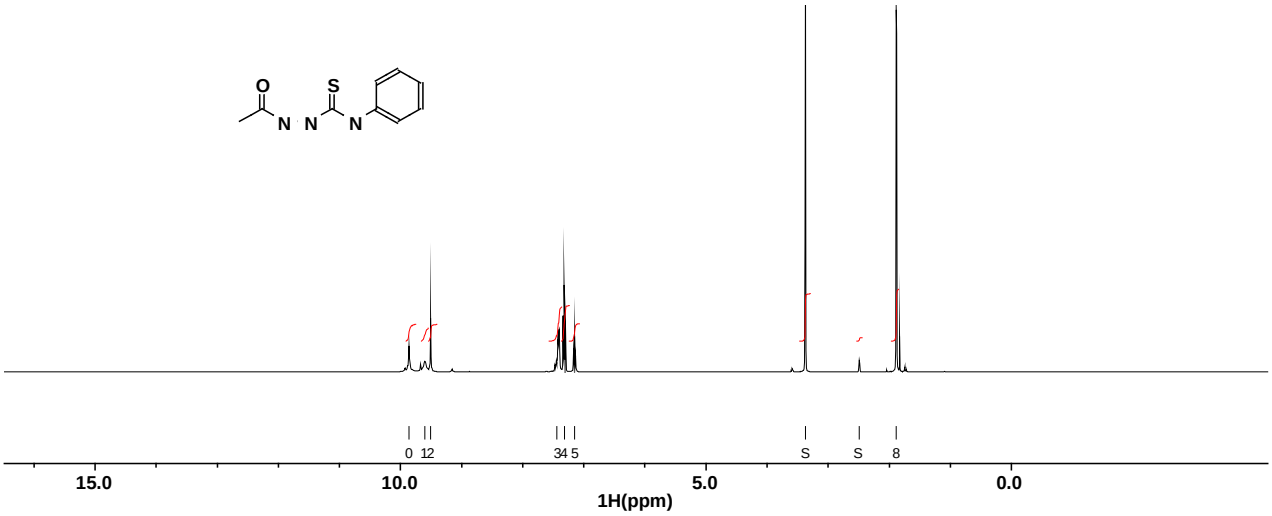


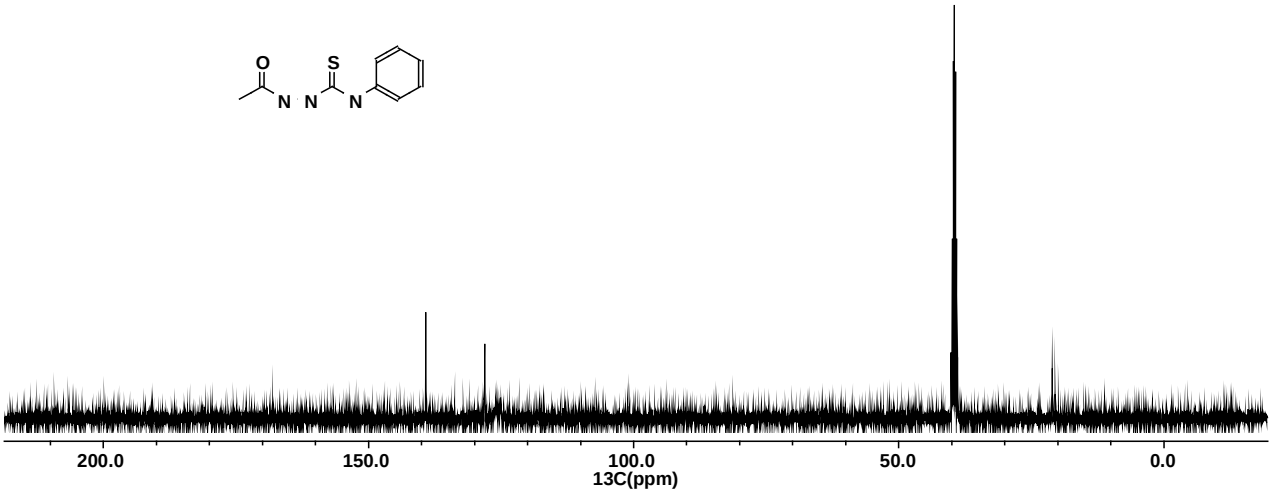



**N-Phenyl acetic acid semicarbazide:**

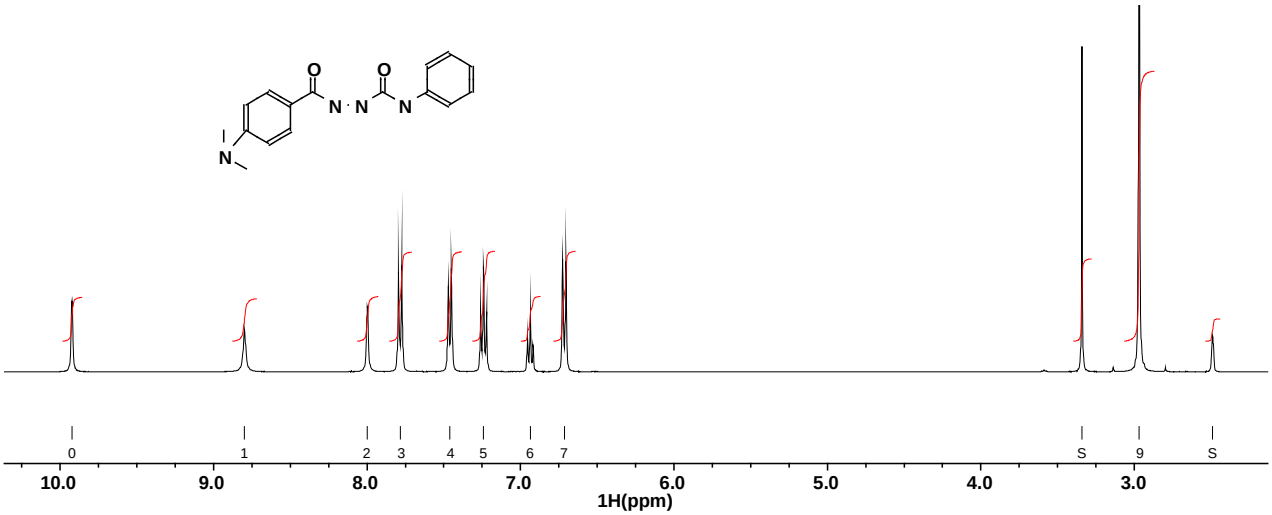


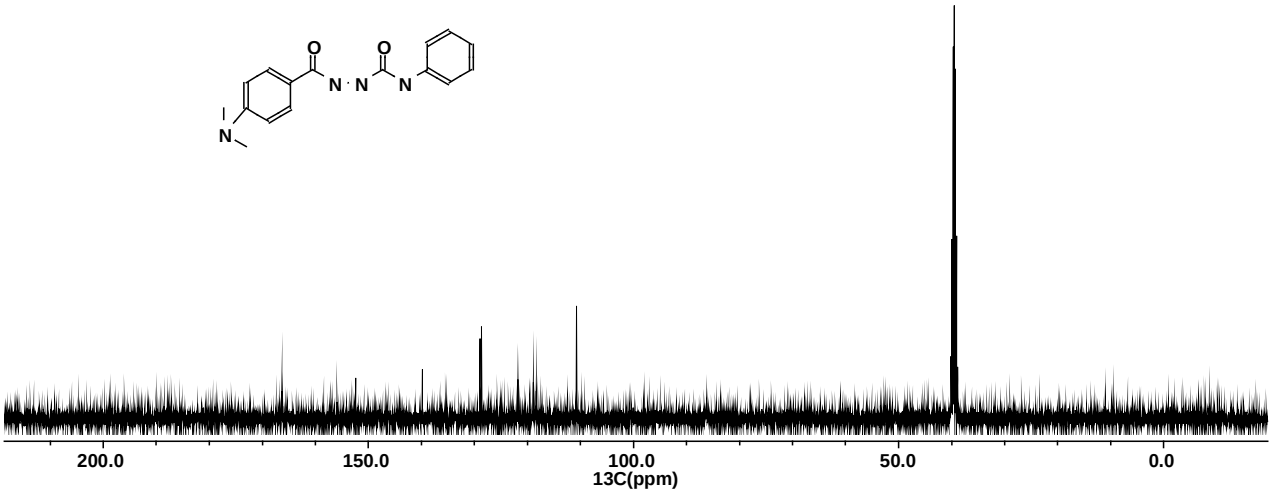
**N-Phenyl acetic acid thiosemicarbazide:**



**N-Phenyl-4-dimethylamino-benzoic acid semicarbazide:**



**N-Phenyl-4-dimethylamino-benzoic acid *thio*-semicarbazide:**