

Base-Catalyzed Multicomponent Access to Quinoxalin-2-thiones from *o*-Phenylenediamines, Aryl Ketones and Sulfur

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Supporting Information

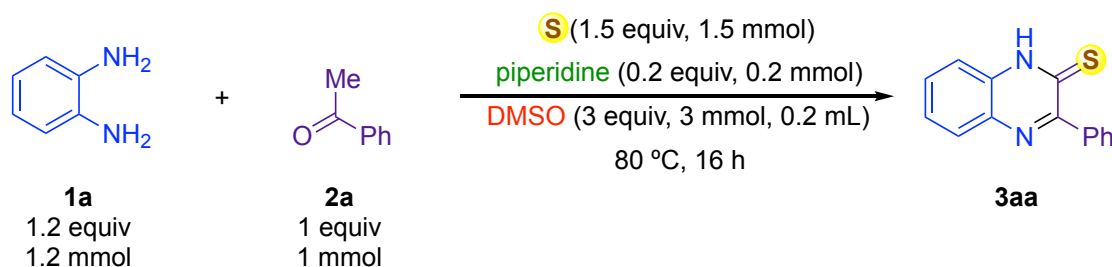
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General Information

All chemicals (S₈, DMSO, DABCO as well as other bases, *o*-phenylenediamine and ketone derivatives) were obtained from commercial supplier and used without further purification. Analytical thin layer chromatography (TLC) was purchased from Merck KGaA (silica gel 60 F254). Visualization of the chromatogram was performed by UV light (254 nm) or KMnO₄ or vanillin stains. Flash column chromatography was carried out using kieselgel 35-70 μm particle sized silica gel (230-400 mesh). NMR Chemical shifts are reported in (δ) ppm relative to tetramethylsilane (TMS) with the residual solvent as internal reference (CDCl₃, δ 7.26 ppm for ¹H and δ 77.0 ppm for ¹³C; (DMSO-d₆, δ 2.50 ppm for ¹H and δ 39.5 ppm for ¹³C). Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants (Hz) and integration.

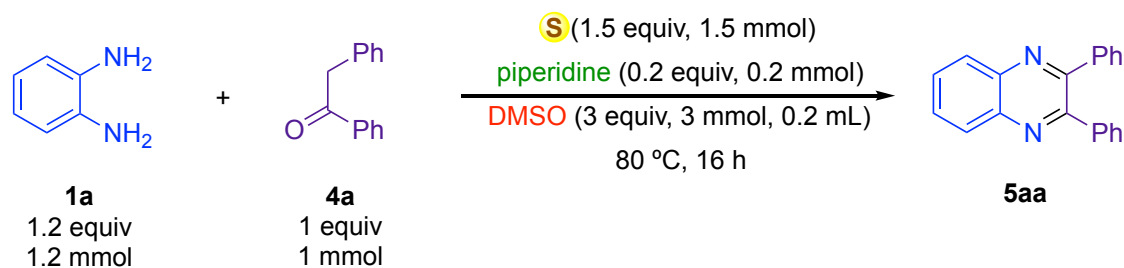
Representative protocol for the synthesis of 3-phenylquinoxaline-2-thione **3aa**



A mixture of *o*-phenylenediamine **1a** (1.2 mmol, 130 mg), acetophenone **2a** (1.0 mmol, 120 mg), sulfur (1.5 mmol, 48 mg) and piperidine (0.2 mmol, 17 mg) in DMSO (0.2 mL) a 7-mL test tube closed with a rubber septum equipped with a deflated rubber balloon was stirred and heated at 80 °C for 16 h. The yellow solid reaction mixture cooled down to room temperature was diluted with MeOH (2-4 mL) with vigorous shaking. The yellow precipitate product **3** was filtered, washed with MeOH (2 mL × 3) and dried in vacuo (183 mg, 77%).

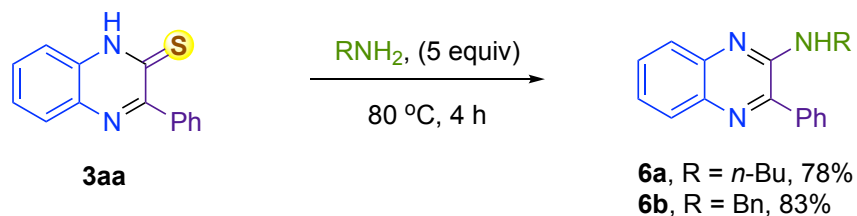
Large-scale synthesis of **3aa**: Similar procedure (a 20-mL test tube was used as a reactor) with *o*-phenylenediamine (12, 1.30 g mmol), sulfur (15 mmol, 480 mg), acetophenone (10 mmol, 1.20 g), DMSO (2 mL) and piperidine (2 mmol, 170 mg) afforded **3aa** (1.81 g, 76%).

Representative protocol for the synthesis of 2,3-diphenylquinoxaline 5aa



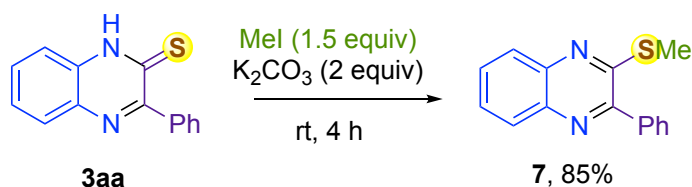
A mixture of *o*-phenylenediamine **1a** (1.2 mmol, 130 mg), benzyl phenyl ketone **4a** (1.0 mmol, 196 mg), sulfur (1.5 mmol, 48 mg) and piperidine (0.2 mmol, 17 mg) in DMSO (0.2 mL) in a 7-mL test tube closed with a rubber septum equipped with a deflated rubber balloon was stirred and heated at 80 °C for 16 h. The solid reaction mixture cooled down to room temperature was purified by column chromatography on a silica gel (eluent: hexane:ethyl acetate 20:1) to afford **5aa** as a white solid (231 mg, 82%).

Representative protocol for the synthesis of quinoxaline 6a



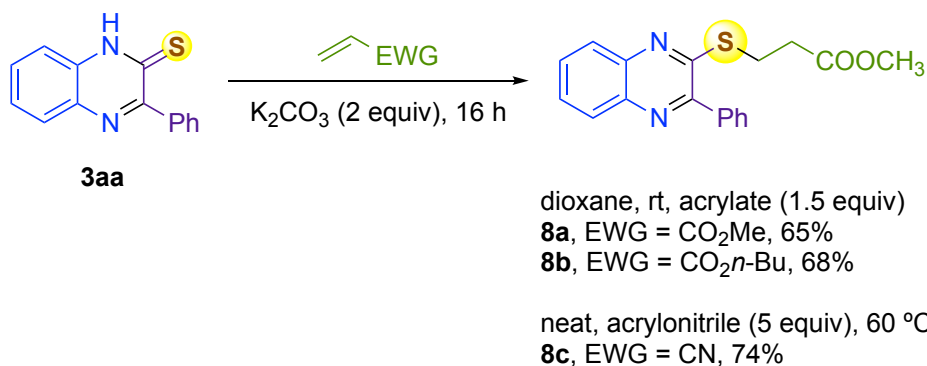
A mixture of quinoxaline-2-thione (**3aa**) (1 mmol, 238 mg) and butylamine (5 mmol, 365 mg) in a 7-mL test tube closed with a rubber septum was stirred and heated at 80 °C for 4 h. The reaction mixture cooled down to rt was diluted in dichloromethane (50 mL). The resulting solution was washed with 1M HCl solution (2 × 25mL), brine and water. The organic layer was dried over Na₂SO₄, filtered and concentrated in vacuo. The residue was purified by flash column chromatography on silica gel (eluent: hexane:ethyl acetate 4:2) to afford the products **6** as pale yellow oil (216 mg, 78%).

Synthesis of quinoxaline 7



A mixture of quinoxaline-2-thione (**3aa**) (1 mmol, 238 mg), K_2CO_3 (2 mmol, 276 mg) and MeI (1.5 mmol, 213 mg) in DMSO (5 mL) in a 7-mL test tube closed with a rubber septum was stirred at rt for 4 h. The reaction mixture was diluted with water (10 mL) and extracted with ethyl acetate (20 mL). The organic layer was separated, dried over Na_2SO_4 , filtered and concentrated in vacuo. The residue was purified by flash column chromatography on silica gel (eluent: hexane:ethyl acetate 90:10) to afford the products **7** as a brown solid (214 mg, 85%).

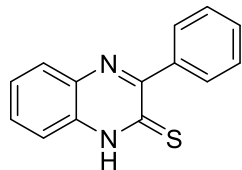
Representative protocol for the synthesis of quinoxaline 8a



A mixture of quinoxaline-2-thione (**3aa**) (1 mmol, 238 mg), K_2CO_3 (2 mmol, 276 mg) and methyl acrylate (1.5 mmol, 129 mg) in dioxane (5 mL) in a 20-mL test tube closed with a rubber septum was stirred at rt for 16 h. The reaction mixture was diluted with water (10 mL) and extracted with ethyl acetate (20 mL). The organic layer was separated, dried over Na_2SO_4 , filtered and concentrated in vacuo. The residue was purified by flash column chromatography on silica gel (eluent: hexane:ethyl acetate 9:1) to afford the products **8a** as a pale yellow oil (211 mg, 65%). In the case of **8c**, the reaction was performed without solvent with 5 equiv of acrylonitrile.

Characterization data of quinoxaline 3, 5, 6, 7 and 8

3-Phenylquinoxaline-2(1H)-thione (3aa)¹

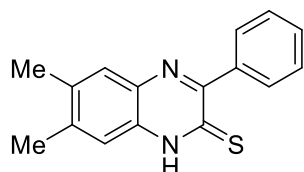


Yellow solid (181 mg, 76%).

¹H NMR (500 MHz, DMSO-*d*₆) δ 7.89 (dd, *J* = 8.2, 1.3 Hz, 1H), 7.87 – 7.82 (m, 2H), 7.67 (ddd, *J* = 8.4, 7.0, 1.4 Hz, 1H), 7.61 (dd, *J* = 8.3, 1.4 Hz, 1H), 7.52 – 7.47 (m, 1H), 7.48 – 7.39 (m, 3H).

¹³C NMR (126 MHz, DMSO) δ 174.8, 160.7, 139.0, 135.9, 132.3, 131.6, 129.9, 129.6, 129.2, 127.7, 126.3, 116.1.

6,7-Dimethyl-3-phenylquinoxaline-2(1H)-thione (3ba)¹



Yellow solid (181 mg, 68%).

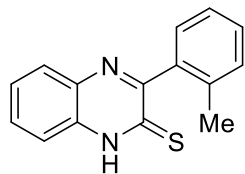
¹H NMR (500 MHz, DMSO-*d*₆) δ 14.41 (s, 1H), 7.84 (dd, *J* = 6.4, 2.2 Hz, 2H), 7.67 (s, 1H), 7.45 – 7.40 (m, 3H), 7.37 (s, 1H).

¹³C NMR (126 MHz, DMSO) δ 173.7, 159.6, 141.7, 139.2, 135.8, 134.7, 130.7, 129.9, 129.4, 128.8, 127.6, 115.8, 20.5, 19.7.

3-(*o*-Tolyl)quinoxaline-2(1H)-thione (3ab)²

¹ Y. Chen and X. Huang, *Synthesis*, 2022, **54**, 2616-2628.

² W. Schaper, L. Willms, C. Rosinger, E. Hacker, E. Rose and D. Schmutzler, US20050256000 A1, 2005,

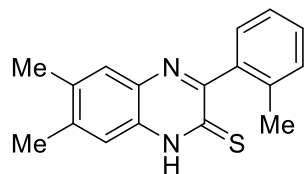


Yellow solid (143 mg, 57%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.54 (s, 1H), 7.86 (dd, $J = 8.1, 1.3$ Hz, 1H), 7.68 (ddd, $J = 8.4, 7.1, 1.4$ Hz, 1H), 7.62 (dd, $J = 8.3, 1.4$ Hz, 1H), 7.48 (ddd, $J = 8.4, 7.1, 1.4$ Hz, 1H), 7.32 (ddd, $J = 8.2, 5.8, 2.8$ Hz, 1H), 7.28 – 7.22 (m, 3H), 2.15 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 175.2, 163.2, 139.6, 135.7, 135.6, 132.4, 131.7, 130.1, 129.2, 128.9, 128.7, 126.2, 125.6, 116.2, 19.6.

6,7-Dimethyl-3-(o-tolyl)quinoxaline-2(1H)-thione (3bb)



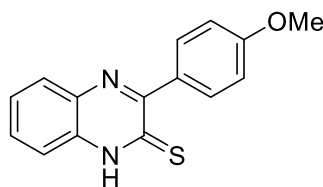
Yellow solid (188 mg, 67%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.41 (s, 1H), 7.63 (s, 1H), 7.39 (s, 1H), 7.30 (dt, $J = 8.3, 4.3$ Hz, 1H), 7.24 (dd, $J = 9.8, 5.9$ Hz, 3H), 2.37 (s, 3H), 2.33 (s, 3H), 2.13 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 174.1, 162.2, 141.7, 139.8, 135.8, 135.6, 134.4, 130.8, 130.1, 129.0, 128.8, 128.5, 125.5, 115.9, 20.5, 19.7, 19.6.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{17}\text{H}_{17}\text{N}_2\text{S}$, 281.1112. Found: 281.1114.

3-(4-Methoxyphenyl)quinoxaline-2(1H)-thione (3ac)¹

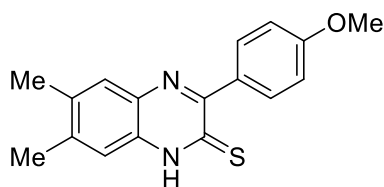


Yellow solid (163 mg, 61%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.45 (s, 1H), 7.94 (d, J = 9.1 Hz, 2H), 7.86 (dd, J = 8.2, 1.2 Hz, 1H), 7.63 (ddd, J = 8.3, 6.9, 1.3 Hz, 1H), 7.58 (dd, J = 8.3, 1.5 Hz, 1H), 7.46 (ddd, J = 8.3, 7.0, 1.5 Hz, 1H), 6.99 (d, J = 8.7 Hz, 2H), 3.83 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 174.8, 160.7, 159.8, 136.0, 131.8, 131.2, 129.1, 126.3, 116.0, 113.0, 55.7

3-(4-Methoxyphenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bc)



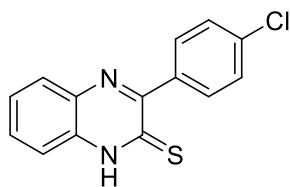
Yellow solid (260 mg, 88%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.35 (s, 1H), 7.93 (d, J = 8.8 Hz, 2H), 7.65 (s, 1H), 7.35 (s, 1H), 6.98 (d, J = 8.9 Hz, 2H), 2.36 (s, 3H), 2.32 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.7, 160.5, 158.7, 135.7, 134.8, 131.7, 131.4, 130.4, 128.7, 115.8, 113.0, 55.7, 20.5, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{17}\text{H}_{17}\text{N}_2\text{OS}$, 297.0162. Found: 297.0167.

3-(4-Chlorophenyl)quinoxaline-2(1H)-thione (3ad)¹

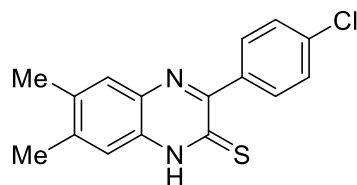


Yellow solid (248 mg, 90%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.55 (s, 1H), 7.89 (d, J = 8.5 Hz, 2H), 7.88 (d, J = 7.0 Hz, 1H), 7.67 (td, J = 7.7, 7.1, 1.4 Hz, 1H), 7.60 (dd, J = 8.3, 1.4 Hz, 1H), 7.51 (d, J = 8.5 Hz, 2H), 7.47 (d, J = 7.0 Hz, 1H).

^{13}C NMR (126 MHz, DMSO) δ 174.6, 159.6, 137.7, 135.9, 134.4, 132.4, 131.8, 129.3, 127.8, 126.4, 116.1.

3-(4-Chlorophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bd)



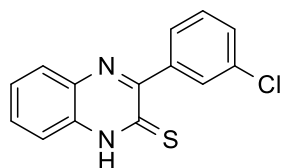
Yellow solid (276 mg, 92%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.37 (s, 1H), 7.89 (d, J = 8.7 Hz, 2H), 7.68 (s, 1H), 7.49 (d, J = 8.4 Hz, 2H), 7.37 (s, 1H), 2.37 (s, 3H), 2.33 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.4, 158.4, 142.0, 137.9, 135.9, 134.7, 134.2, 131.9, 130.8, 129.3, 128.9, 127.7, 115.9, 20.5, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{16}\text{H}_{14}\text{ClN}_2\text{S}$, 301.0566. Found: 301.0568.

3-(3-Chlorophenyl)quinoxaline-2(1H)-thione (3ae)²

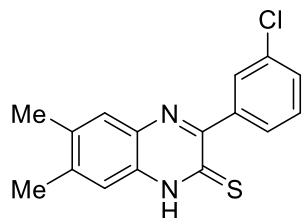


Yellow solid (232 mg, 84%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.57 (s, 1H), 7.93 – 7.89 (m, 1H), 7.88 (d, J = 1.8 Hz, 1H), 7.79 (dt, J = 7.5, 1.5 Hz, 1H), 7.69 (ddd, J = 8.4, 7.2, 1.4 Hz, 1H), 7.61 (dd, J = 8.3, 1.4 Hz, 1H), 7.53 (ddd, J = 8.1, 2.1, 1.3 Hz, 1H), 7.52 – 7.46 (m, 1H), 7.50 – 7.45 (m, 1H).

^{13}C NMR (126 MHz, DMSO) δ 174.5, 159.3, 140.9, 135.8, 132.5, 132.4, 132.0, 129.7, 129.6, 129.4, 129.4, 128.6, 126.5, 116.1.

3-(3-Chlorophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3be)



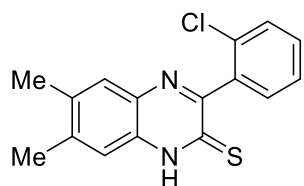
Yellow solid (243 mg, 81%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.47 (s, 1H), 7.89 (t, $J = 1.9$ Hz, 1H), 7.80 (dt, $J = 7.4, 1.5$ Hz, 1H), 7.69 (s, 1H), 7.51 (ddd, $J = 8.1, 2.2, 1.3$ Hz, 1H), 7.47 (t, $J = 7.7$ Hz, 1H), 7.37 (s, 1H), 2.37 (s, 3H), 2.34 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.3, 158.1, 142.2, 141.1, 136.0, 134.7, 132.3, 130.9, 129.7, 129.3, 128.9, 128.7, 115.9, 20.5, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{16}\text{H}_{14}\text{ClN}_2\text{S}$, 301.0566. Found: 301.0570.

3-(2-Chlorophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bf)²

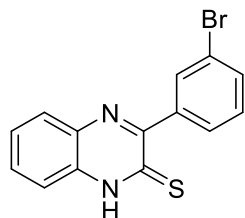


Yellow solid (171 mg, 57%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.48 (s, 1H), 7.66 (s, 1H), 7.51 (dt, $J = 7.5, 1.2$ Hz, 1H), 7.48 – 7.41 (m, 3H), 7.39 (s, 1H), 2.38 (s, 3H), 2.33 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.8, 160.0, 142.3, 138.9, 135.8, 134.2, 132.1, 131.0, 130.9, 130.3, 129.5, 128.9, 127.2, 116.0, 20.5, 19.7.

3-(3-Bromophenyl)quinoxaline-2(1H)-thione (3ag)



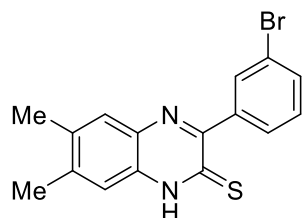
Yellow solid (276 mg, 87%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.57 (s, 1H), 8.01 (t, J = 1.8 Hz, 1H), 7.90 (dd, J = 8.1, 1.3 Hz, 1H), 7.84 (dt, J = 7.7, 1.3 Hz, 1H), 7.72 – 7.64 (m, 2H), 7.60 (dd, J = 8.4, 1.3 Hz, 1H), 7.49 (ddd, J = 8.3, 7.1, 1.4 Hz, 1H), 7.42 (t, J = 7.9 Hz, 1H).

^{13}C NMR (126 MHz, DMSO) δ 174.5, 159.2, 141.2, 135.8, 132.5, 132.4, 132.3, 132.0, 130.0, 129.4, 129.0, 126.5, 120.8, 116.2.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{14}\text{H}_{10}\text{BrN}_2\text{S}$, 316.9748. Found: 316.9752.

3-(3-Bromophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bg)



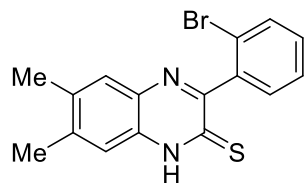
Yellow solid (265 mg, 77%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.46 (s, 1H), 8.02 (t, J = 1.9 Hz, 1H), 7.85 (dt, J = 7.8, 1.3 Hz, 1H), 7.67 (s, 1H), 7.64 (ddd, J = 8.1, 2.2, 1.0 Hz, 1H), 7.40 (t, J = 7.9 Hz, 1H), 7.36 (s, 1H), 2.36 (s, 3H), 2.32 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.3, 158.0, 142.2, 141.3, 135.9, 134.7, 132.5, 132.1, 130.8, 129.9, 129.0, 128.9, 120.8, 115.9, 20.5, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{16}\text{H}_{14}\text{BrN}_2\text{S}$, 345.0061. Found: 345.0058.

3-(2-Bromophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bh)



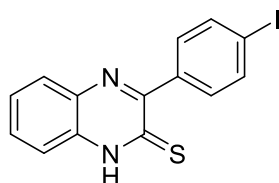
Yellow solid (186 mg, 54%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.47 (s, 1H), 7.68 (dd, J = 8.0, 1.2 Hz, 1H), 7.66 (s, 1H), 7.46 (td, J = 7.4, 1.2 Hz, 1H), 7.41 (dd, J = 7.6, 1.8 Hz, 1H), 7.39 (s, 1H), 7.36 (ddd, J = 8.1, 7.2, 1.9 Hz, 1H), 2.38 (s, 3H), 2.33 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.6, 161.1, 142.2, 140.8, 135.8, 134.2, 132.5, 131.0, 130.9, 130.4, 128.9, 127.7, 122.1, 116.0, 20.5, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{16}\text{H}_{14}\text{BrN}_2\text{S}$, 345.0061. Found: 345.0057.

3-(4-Iodophenyl)quinoxaline-2(1H)-thione (3ai)



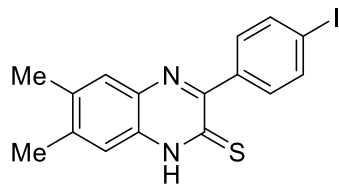
Yellow solid (236 mg, 65%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.54 (s, 1H), 7.88 (dd, J = 8.1, 1.3 Hz, 1H), 7.82 (d, J = 8.4 Hz, 2H), 7.69 – 7.63 (m, 3H), 7.59 (dd, J = 8.2, 1.3 Hz, 1H), 7.47 (ddd, J = 8.3, 7.1, 1.4 Hz, 1H).

^{13}C NMR (126 MHz, DMSO) δ 174.5, 159.8, 138.5, 136.6, 135.9, 132.4, 132.0, 131.8, 129.3, 126.4, 116.1, 96.6.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{14}\text{H}_{10}\text{IN}_2\text{S}$, 364.9609. Found: 364.9612.

3-(4-Iodophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bi)



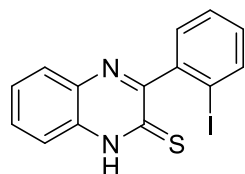
Yellow solid (273 mg, 83%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.87 (s, 1H), 8.23 (d, $J = 8.4$ Hz, 2H), 8.09 (s, 1H), 8.08 (d, $J = 8.4$ Hz, 2H), 7.79 (s, 1H), 2.79 (s, 3H), 2.75 (s, 3H).

^{13}C NMR (126 MHz, $\text{DMSO-}d_6$) δ 173.7, 159.1, 142.5, 139.1, 137.0, 136.3, 135.2, 132.5, 131.2, 129.3, 116.3, 96.7, 20.9, 20.1.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{16}\text{H}_{14}\text{IN}_2\text{S}$, 392.9922. Found: 392.9926.

3-(2-Iodophenyl)quinoxaline-2(1H)-thione (3aj)



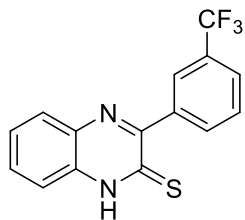
Yellow solid (230 mg, 63%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 8.03 (d, $J = 8.0$ Hz, 2H), 7.89 (dd, $J = 8.2, 1.3$ Hz, 1H), 7.80 (d, $J = 8.2$ Hz, 2H), 7.72 – 7.66 (m, 1H), 7.61 (dd, $J = 8.3, 1.3$ Hz, 1H), 7.52 – 7.45 (m, 1H).

^{13}C NMR (126 MHz, DMSO) δ 173.9, 159.1, 142.5, 135.3, 132.0, 131.5, 130.2, 128.8, 125.9, 124.2, 124.1, 124.1, 115.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{14}\text{H}_{10}\text{IN}_2\text{S}$, 364.9609. Found: 364.9614.

3-(3-(Trifluoromethyl)phenyl)quinoxaline-2(1H)-thione (3ak)²

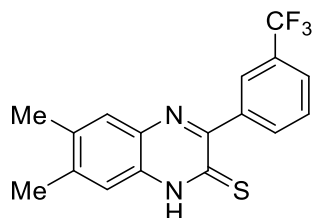


Yellow solid (199 mg, 65%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.62 (s, 1H), 8.20 (d, J = 1.8 Hz, 1H), 8.15 (d, J = 7.7 Hz, 1H), 7.92 (dd, J = 8.2, 1.3 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.70 (td, J = 7.7, 7.1, 1.2 Hz, 2H), 7.62 (dd, J = 8.2, 1.3 Hz, 1H), 7.50 (ddd, J = 8.3, 7.1, 1.4 Hz, 1H).

^{13}C NMR (126 MHz, DMSO) δ 174.5, 159.3, 139.8, 135.9, 134.0, 132.6, 132.1, 129.4, 128.9, 126.6, 126.5, 126.5, 116.2.

6,7-Dimethyl-3-(3-(trifluoromethyl)phenyl)quinoxaline-2(1H)-thione (3bk)



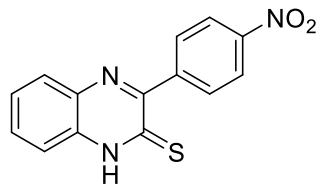
Yellow solid (254 mg, 76%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.52 (s, 1H), 8.20 (d, J = 1.8 Hz, 1H), 8.16 (d, J = 7.8 Hz, 1H), 7.81 (d, J = 8.1 Hz, 1H), 7.71 (s, 1H), 7.68 (t, J = 7.8 Hz, 1H), 7.39 (s, 1H), 2.38 (s, 3H), 2.34 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.3, 158.1, 142.3, 140.0, 136.0, 134.8, 134.0, 131.0, 129.0, 128.9, 126.6, 126.6, 126.0, 115.9, 20.5, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{17}\text{H}_{14}\text{F}_3\text{N}_2\text{S}$, 335.0830. Found: 335.0835.

3-(4-Nitrophenyl)quinoxaline-2(1H)-thione (3al)¹

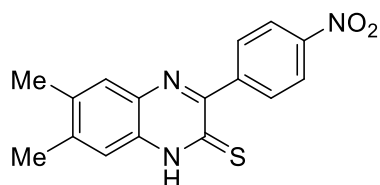


Yellow solid (170 mg, 60%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.65 (s, 1H), 8.30 (d, $J = 8.8$ Hz, 2H), 8.08 (d, $J = 8.8$ Hz, 2H), 7.91 (dd, $J = 8.1, 1.4$ Hz, 1H), 7.71 (ddd, $J = 8.5, 7.0, 1.4$ Hz, 1H), 7.62 (dd, $J = 8.3, 1.3$ Hz, 1H), 7.50 (ddd, $J = 8.3, 7.1, 1.4$ Hz, 1H).

^{13}C NMR (126 MHz, DMSO) δ 174.3, 159.2, 148.0, 145.4, 135.9, 132.4, 131.3, 129.5, 126.6, 123.0, 116.3, 49.1

6,7-Dimethyl-3-(4-nitrophenyl)quinoxaline-2(1H)-thione (3bl)



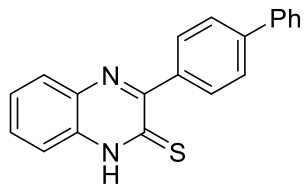
Yellow solid (193 mg, 62%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.51 (s, 1H), 8.29 (d, $J = 8.7$ Hz, 2H), 8.09 (d, $J = 8.8$ Hz, 2H), 7.70 (s, 1H), 7.39 (s, 1H), 2.38 (s, 3H), 2.34 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.1, 158.0, 147.9, 145.6, 142.7, 136.1, 134.7, 131.3, 129.0, 122.9, 116.0, 20.6, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{16}\text{H}_{14}\text{N}_3\text{O}_2\text{S}$, 312.0807. Found: 312.0811.

3-([1,1'-Biphenyl]-4-yl)quinoxaline-2(1H)-thione (3am)¹

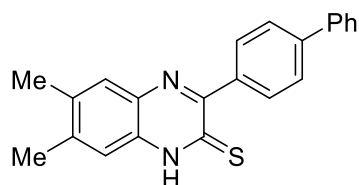


Yellow solid (251 mg, 80%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.53 (s, 1H), 7.99 (d, $J = 8.4$ Hz, 2H), 7.90 (dd, $J = 8.1, 1.3$ Hz, 1H), 7.79 – 7.71 (m, 4H), 7.67 (ddd, $J = 8.4, 7.0, 1.4$ Hz, 1H), 7.61 (dd, $J = 8.3, 1.4$ Hz, 1H), 7.54 – 7.46 (m, 3H), 7.45 – 7.37 (m, 1H).

^{13}C NMR (126 MHz, DMSO) δ 174.8, 160.2, 141.3, 140.1, 138.0, 136.0, 132.3, 131.7, 130.6, 129.5, 129.3, 128.2, 127.2, 126.4, 126.0, 116.1.

3-([1,1'-Biphenyl]-4-yl)-6,7-dimethylquinoxaline-2(1H)-thione (3bm)



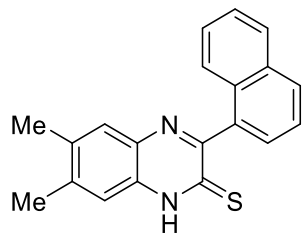
Yellow solid (294 mg, 86%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.43 (s, 1H), 7.99 (d, $J = 8.3$ Hz, 2H), 7.77 – 7.70 (m, 4H), 7.68 (s, 1H), 7.51 (dd, $J = 8.4, 7.0$ Hz, 2H), 7.42 (d, $J = 7.4$ Hz, 1H), 7.38 (s, 1H), 2.37 (s, 3H), 2.34 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.6, 159.1, 141.8, 141.1, 140.1, 138.2, 135.8, 134.8, 130.7, 130.6, 129.5, 128.8, 128.2, 127.2, 125.9, 115.8, 20.5, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{22}\text{H}_{19}\text{N}_2\text{S}$, 343.1269. Found: 343.1274.

6,7-Dimethyl-3-(naphthalen-1-yl)quinoxaline-2(1H)-thione (3bn)



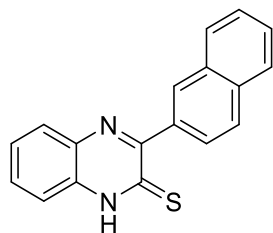
Yellow solid (250 mg, 79%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.50 (s, 1H), 7.98 (d, J = 7.9 Hz, 2H), 7.66 (s, 1H), 7.58 (dd, J = 8.1, 7.0 Hz, 1H), 7.54 – 7.48 (m, 3H), 7.44 (s, 1H), 7.43 – 7.37 (m, 1H), 2.40 (s, 3H), 2.34 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 174.7, 161.3, 141.9, 137.6, 135.7, 134.6, 133.4, 131.4, 131.1, 128.9, 128.7, 128.6, 126.9, 126.5, 126.2, 126.0, 125.6, 116.0, 20.5, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{20}\text{H}_{17}\text{N}_2\text{S}$, 317.1112. Found: 317.1117.

3-(Naphthalen-2-yl)quinoxaline-2(1H)-thione (3a)



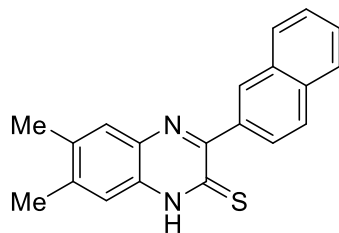
Yellow solid (207 mg, 72%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.58 (s, 1H), 8.41 (d, J = 1.6 Hz, 1H), 8.01 (d, J = 7.1 Hz, 1H), 8.00 – 7.95 (m, 3H), 7.92 (d, J = 9.3 Hz, 1H), 7.72 – 7.66 (m, 1H), 7.63 (dd, J = 8.3, 1.5 Hz, 1H), 7.61 – 7.54 (m, 2H), 7.50 (ddd, J = 8.4, 7.1, 1.5 Hz, 1H).

^{13}C NMR (126 MHz, DMSO) δ 174.9, 160.6, 141.2, 136.7, 136.0, 133.6, 132.6, 132.4, 131.7, 129.3, 129.3, 128.9, 128.0, 127.6, 127.4, 126.7, 126.7, 126.4, 116.2.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{18}\text{H}_{13}\text{N}_2\text{S}$, 289.0799. Found: 289.0793.

6,7-Dimethyl-3-(naphthalen-2-yl)quinoxaline-2(1H)-thione (3bo)



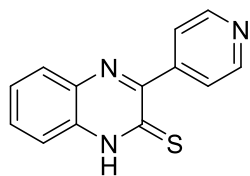
Yellow solid (284 mg, 90%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.48 (s, 1H), 8.40 (d, $J = 1.6$ Hz, 1H), 8.02 – 7.95 (m, 3H), 7.93 (d, $J = 8.6$ Hz, 1H), 7.72 (s, 1H), 7.61 – 7.53 (m, 2H), 7.40 (s, 1H), 2.39 (s, 3H), 2.35 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.8, 159.6, 141.8, 136.9, 135.9, 134.9, 133.5, 132.6, 130.7, 129.3, 128.9, 127.9, 127.7, 127.3, 126.9, 126.7, 126.6, 115.9, 20.5, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{20}\text{H}_{17}\text{N}_2\text{S}$, 317.1112. Found: 317.1117.

3-(Pyridin-4-yl)quinoxaline-2(1H)-thione (3ap)



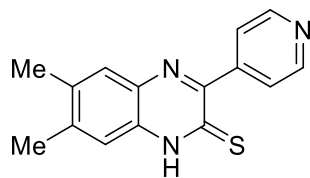
Yellow solid (203 mg, 85%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 8.68 (d, $J = 7.7$ Hz, 2H), 7.91 (dd, $J = 8.3, 1.2$ Hz, 1H), 7.77 (d, $J = 6.3$ Hz, 2H), 7.71 (ddd, $J = 8.5, 7.1, 1.4$ Hz, 1H), 7.62 (dd, $J = 8.3, 1.3$ Hz, 1H), 7.50 (ddd, $J = 8.4, 7.1, 1.3$ Hz, 1H).

^{13}C NMR (126 MHz, DMSO) δ 174.2, 158.9, 149.5, 146.4, 135.8, 132.7, 132.4, 129.5, 126.5, 124.2, 116.3.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{13}\text{H}_{10}\text{N}_3\text{S}$, 240.0595. Found: 240.0599.

6,7-Dimethyl-3-(pyridin-4-yl)quinoxaline-2(1H)-thione (3bp)



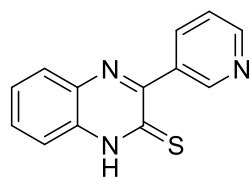
Yellow solid (181 mg, 68%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.53 (s, 1H), 8.66 (d, $J = 6.0$ Hz, 2H), 7.78 (d, $J = 6.0$ Hz, 2H), 7.70 (s, 1H), 7.38 (s, 1H), 2.38 (s, 3H), 2.34 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 173.0, 157.7, 149.4, 146.5, 142.7, 136.1, 134.7, 131.1, 129.0, 124.3, 116.0, 20.6, 19.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{15}\text{H}_{14}\text{N}_3\text{S}$, 268.0908. Found: 268.0912.

3-(Pyridin-3-yl)quinoxaline-2(1H)-thione (3aq)



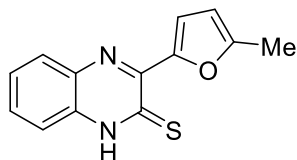
Yellow solid (231 mg, 97%).

^1H NMR (500 MHz, $\text{CDCl}_3 + \text{TFA}$) δ 9.67 (s, 1H), 9.36 (d, $J = 8.1$ Hz, 1H), 8.95 (d, $J = 5.8$ Hz, 1H), 8.16 (dd, $J = 8.1, 6.0$ Hz, 1H), 8.09 (d, $J = 8.2$ Hz, 1H), 7.86 (t, $J = 7.7$ Hz, 1H), 7.69 (d, $J = 7.6$ Hz, 2H), 7.61 (d, $J = 8.2$ Hz, 1H).

^{13}C NMR (126 MHz, $\text{CDCl}_3 + \text{TFA}$) δ 172.1, 152.2, 147.4, 142.7, 141.3, 137.4, 136.3, 134.4, 130.0, 128.4, 126.4, 115.8, 115.6, 113.3.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{13}\text{H}_{10}\text{N}_3\text{S}$, 240.0595. Found: 240.0591.

3-(5-Methylfuran-2-yl)quinoxaline-2(1H)-thione (3ar)



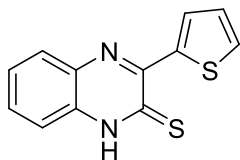
Brown solid (99 mg, 41%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.51 (s, 1H), 8.29 (d, J = 3.4 Hz, 1H), 7.90 (d, J = 8.1 Hz, 1H), 7.59 (d, J = 3.3 Hz, 2H), 7.46 (ddd, J = 8.4, 5.2, 3.3 Hz, 1H), 6.35 (d, J = 3.4 Hz, 1H), 2.43 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 171.5, 155.4, 148.5, 147.6, 135.0, 130.4, 130.3, 128.3, 126.0, 121.5, 115.6, 108.7, 13.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{13}\text{H}_{11}\text{N}_2\text{OS}$, 243.0592. Found: 243.0597.

3-(Thiophen-2-yl)quinoxaline-2(1H)-thione (3as)¹

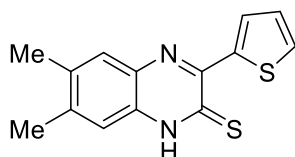


Yellow solid (168 mg, 69%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.64 (s, 1H), 8.71 (dd, J = 3.9, 1.2 Hz, 1H), 7.88 (dd, J = 8.2, 1.3 Hz, 1H), 7.82 (dd, J = 5.1, 1.3 Hz, 1H), 7.72 – 7.58 (m, 2H), 7.50 (ddd, J = 8.3, 6.7, 1.8 Hz, 1H), 7.22 (dd, J = 5.0, 3.8 Hz, 1H).

^{13}C NMR (126 MHz, DMSO) δ 172.4, 152.3, 141.0, 135.5, 133.6, 133.0, 131.3, 128.8, 127.5, 126.7, 116.1.

6,7-Dimethyl-3-(thiophen-2-yl)quinoxaline-2(1H)-thione (3bs)



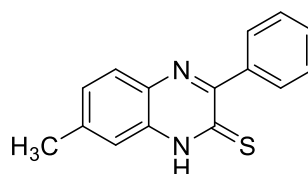
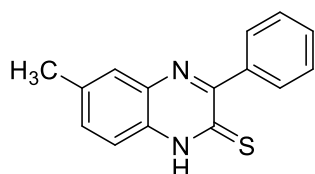
Yellow solid (193 mg, 71%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.52 (s, 1H), 8.69 (dd, $J = 3.8, 1.3$ Hz, 1H), 7.77 (dd, $J = 5.1, 1.3$ Hz, 1H), 7.66 (s, 1H), 7.36 (s, 1H), 7.20 (dd, $J = 5.1, 3.8$ Hz, 1H), 2.36 (s, 3H), 2.33 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 171.2, 151.4, 141.6, 141.4, 136.3, 134.3, 133.0, 132.4, 129.7, 128.3, 127.5, 115.8, 20.5, 19.7

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{14}\text{H}_{13}\text{N}_2\text{S}_2$, 273.0520. Found: 273.0527.

6-Methyl-3-phenylquinoxaline-2(1H)-thione and 7-methyl-3-phenylquinoxaline-2(1H)-thione (3ca)



6-methyl-3-phenylquinoxaline-2(1H)-thione 7-methyl-3-phenylquinoxaline-2(1H)-thione

Yellow solid (184 mg, 73%).

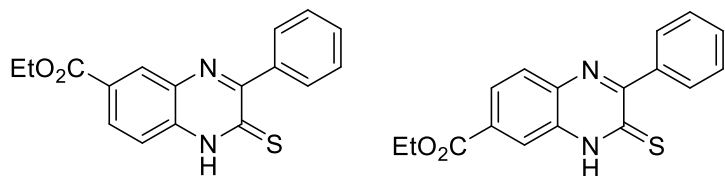
1:1 Mixture of two regioisomers

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.48 (s, 1H), 14.44 (s, 1H), 7.84 (tt, $J = 4.3, 2.2$ Hz, 3H), 7.77 (d, $J = 8.3$ Hz, 1H), 7.69 (s, 1H), 7.50 (d, $J = 1.2$ Hz, 2H), 7.47 – 7.41 (m, 5H), 7.38 (s, 1H), 7.31 (dd, $J = 8.3, 1.8$ Hz, 1H), 2.46 (s, 3H), 2.42 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 174.6, 173.9, 160.6, 159.7, 142.2, 139.1, 136.1, 136.0, 134.4, 133.0, 132.3, 130.4, 129.9, 129.9, 129.5, 129.5, 129.0, 128.6, 127.9, 127.7, 115.8, 115.5, 22.0, 21.2.

HRMS m/z : calcd for $[\text{M} + \text{H}]^+$ $\text{C}_{15}\text{H}_{13}\text{N}_2\text{S}$, 253.0799. Found: 253.0805.

Ethyl 3-phenyl-2-thioxo-1,2-dihydroquinoxaline-6-carboxylate or ethyl 2-phenyl-3-thioxo-3,4-dihydroquinoxaline-6-carboxylate (3ka)



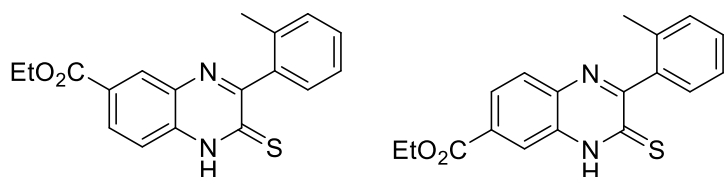
Yellow solid (233 mg, 75%).

^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.61 (s, 1H), 8.19 (q, $J = 1.8$ Hz, 1H), 7.96 (dd, $J = 9.3, 6.7$ Hz, 2H), 7.86 (dt, $J = 7.8, 1.6$ Hz, 2H), 7.52 – 7.41 (m, 3H), 4.38 (qd, $J = 7.0, 1.9$ Hz, 2H), 1.36 (td, $J = 7.2, 1.6$ Hz, 3H).

^{13}C NMR (126 MHz, DMSO) δ 175.7, 165.2, 162.5, 138.7, 138.2, 132.1, 131.7, 130.0, 129.9, 129.6, 127.7, 125.9, 117.3, 61.9, 14.6.

HRMS m/z : calcd for $[\text{M} + \text{H}]^+$ $\text{C}_{17}\text{H}_{15}\text{N}_2\text{O}_2\text{S}$: 311.0854. Found: 311.0859.

Ethyl 2-thioxo-3-(o-tolyl)-1,2-dihydroquinoxaline-6-carboxylate /or ethyl 3-thioxo-2-(o-tolyl)-3,4-dihydroquinoxaline-6-carboxylate (3ka)



Yellow solid (230 mg, 71%).

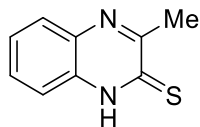
^1H NMR (500 MHz, $\text{DMSO-}d_6$) δ 14.66 (s, 1H), 8.22 (s, 1H), 7.95 (s, 2H), 7.49 – 6.80 (m, 4H), 4.39 (q, $J = 7.1$ Hz, 2H), 2.16 (s, 3H), 1.37 (t, $J = 7.1$ Hz, 3H).

^{13}C NMR (126 MHz, DMSO) δ 176.0, 165.2, 139.3, 137.9, 135.6, 132.4, 131.8, 130.2, 129.6, 128.9, 128.8, 125.8, 125.6, 117.5, 62.0, 19.6, 14.6.

HRMS m/z : calcd for $[\text{M} + \text{H}]^+$ $\text{C}_{18}\text{H}_{17}\text{N}_2\text{O}_2\text{S}$: 325.1011. Found: 325.1016.

3-Methylquinoxaline-2(1H)-thione (3at)³

³ W. Fathalla, I. A. I. Ali and P. Pazdera, *Beilstein J. Org. Chem.*, 2017, **13**, 174-181.

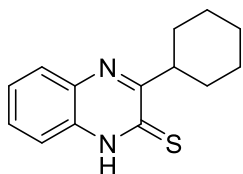


Yellow solid (25 mg, 14%).

^1H NMR (500 MHz, DMSO- d_6) δ 14.37 (s, 1H), 7.81 (dd, J = 8.1, 1.3 Hz, 1H), 7.60 (ddd, J = 8.3, 6.8, 1.4 Hz, 1H), 7.56 (dd, J = 8.3, 1.6 Hz, 1H), 7.45 (ddd, J = 8.3, 6.9, 1.6 Hz, 1H), 2.65 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ 175.0, 161.4, 134.8, 131.6, 130.1, 128.0, 125.6, 115.6, 24.6.

3-Cyclohexylquinoxaline-2(1H)-thione (3au)



Yellow solid (80 mg, 33%).

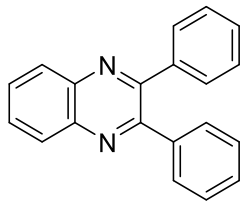
^1H NMR (500 MHz, CDCl_3 + TFA) δ 8.05 (d, J = 8.2 Hz, 1H), 7.72 (t, J = 7.8 Hz, 1H), 7.58 (t, J = 7.9 Hz, 1H), 7.53 (d, J = 8.3 Hz, 1H), 3.96 (dd, J = 19.2, 8.5 Hz, 1H), 2.04 (d, J = 12.5 Hz, 2H), 1.96 (d, J = 13.4 Hz, 2H), 1.84 (d, J = 13.4 Hz, 1H), 1.69 (q, J = 12.5 Hz, 2H), 1.50 (qd, J = 12.9, 6.4 Hz, 2H), 1.43 – 1.29 (m, 1H).

^{13}C NMR (126 MHz, CDCl_3 + TFA) δ 173.0, 167.8, 160.6, 160.3, 132.4, 132.1, 131.5, 127.8, 126.0, 118.1, 115.8, 115.7, 113.5, 111.3, 42.9, 30.6, 26.1, 25.5.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{14}\text{H}_{17}\text{N}_2\text{S}$, 245.1112. Found: 245.1115.

2,3-Diphenylquinoxaline (5aa)⁴

⁴ L. Kong, J. Meng, W. Tian, J. Liu, X. Hu, Z. Jiang, W. Zhang, Y. Li and L. Bai, *ACS Omega*, 2022, 7, 1380-1394.

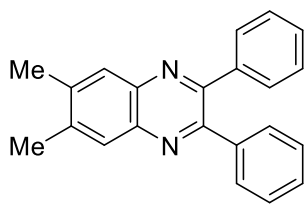


White solid (231 mg, 82%).

^1H NMR (500 MHz, CDCl_3) δ 8.19 (dd, $J = 6.4, 3.5$ Hz, 2H), 7.78 (dd, $J = 6.5, 3.4$ Hz, 2H), 7.53 (d, $J = 5.5$ Hz, 4H), 7.40 – 7.30 (m, 6H).

^{13}C NMR (126 MHz, CDCl_3) δ 153.6, 141.4, 139.2, 130.1, 130.0, 129.3, 128.9, 128.4.

6,7-Dimethyl-2,3-diphenylquinoxaline (5ba)¹¹

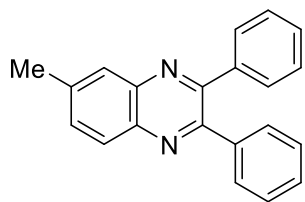


White solid (266 mg, 86%).

^1H NMR (500 MHz, CDCl_3) δ 7.93 (s, 2H), 7.50 (d, $J = 0.6$ Hz, 4H), 7.38 – 7.28 (m, 6H), 2.52 (s, 6H).

^{13}C NMR (126 MHz, CDCl_3) δ 152.6, 140.7, 140.4, 139.5, 130.0, 128.7, 128.4, 128.3, 20.6.

6-Methyl-2,3-diphenylquinoxaline (5ca)⁴

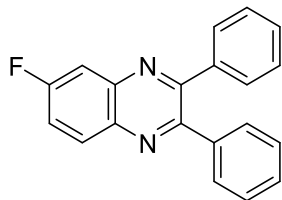


White solid (216 mg, 73%).

^1H NMR (500 MHz, CDCl_3) δ 8.06 (d, $J = 8.5$ Hz, 1H), 7.95 (s, 1H), 7.61 (d, $J = 7.3$ Hz, 1H), 7.50 (d, $J = 4.5$ Hz, 4H), 7.39 – 7.29 (m, 6H), 2.62 (s, 3H).

^{13}C NMR (126 MHz, CDCl_3) δ 153.5, 152.7, 141.4, 140.6, 139.9, 139.4, 132.4, 130.1, 130.0, 128.9, 128.8, 128.7, 128.4, 128.2, 22.1.

6-Fluoro-2,3-diphenylquinoxaline (5da)⁵

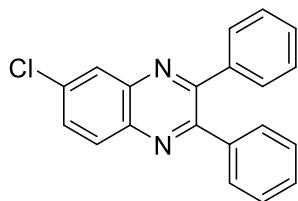


White solid (201 mg, 67%).

^1H NMR (500 MHz, CDCl_3) δ 8.18 (dd, $J = 9.3, 5.8$ Hz, 1H), 7.80 (dt, $J = 9.5, 2.4$ Hz, 1H), 7.60 – 7.54 (m, 1H), 7.51 (t, $J = 6.3$ Hz, 4H), 7.41 – 7.31 (m, 6H).

^{13}C NMR (126 MHz, CDCl_3) δ 163.0 (d, $J = 251.8$ Hz), 154.4, 153.0, 142.1 (d, $J = 13.6$ Hz), 138.9 (d, $J = 11.4$ Hz), 138.6, 131.4 (d, $J = 10.1$ Hz), 130.0, 129.9, 129.2, 129.0, 128.5, 120.5 (d, $J = 26.1$ Hz), 112.8 (d, $J = 21.6$ Hz).

6-Chloro-2,3-diphenylquinoxaline (5ea)⁴



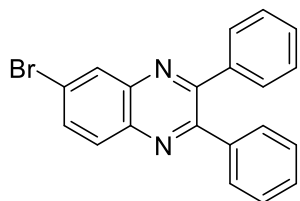
White solid (221 mg, 70%).

^1H NMR (500 MHz, CDCl_3) δ 8.17 (d, $J = 2.4$ Hz, 1H), 8.11 (d, $J = 8.9$ Hz, 1H), 7.71 (dd, $J = 8.9, 2.3$ Hz, 1H), 7.51 (d, $J = 6.2$ Hz, 4H), 7.42 – 7.30 (m, 6H).

⁵ A. Go, G. Lee, J. Kim, S. Bae, B. M. Lee and B. H. Kim, *Tetrahedron*, 2015, **71**, 1215-1226.

^{13}C NMR (126 MHz, CDCl_3) δ 154.2, 153.8, 141.7, 139.9, 138.9, 138.8, 135.8, 131.1, 130.6, 130.0, 129.9, 129.3, 129.2, 128.5, 128.2.

6-Bromo-2,3-diphenylquinoxaline (5fa)⁴

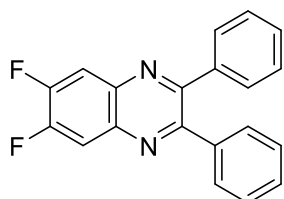


White solid (220 mg, 61%).

^1H NMR (500 MHz, CDCl_3) δ 8.36 (d, $J = 2.1$ Hz, 1H), 8.03 (d, $J = 8.9$ Hz, 1H), 7.84 (dd, $J = 8.9$, 2.2 Hz, 1H), 7.51 (d, 4H), 7.42 – 7.30 (m, 6H).

^{13}C NMR (126 MHz, CDCl_3) δ 154.4, 153.9, 141.9, 140.1, 138.9, 138.8, 133.6, 131.5, 130.7, 130.0, 129.9, 129.3, 129.2, 128.5, 128.5, 124.0.

6,7-Difluoro-2,3-diphenylquinoxaline (5ga)⁶



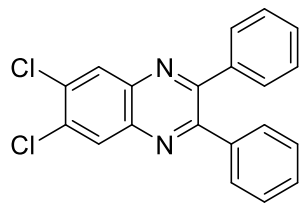
White solid (203 mg, 64%).

^1H NMR (500 MHz, CDCl_3) δ 7.91 (t, $J = 9.3$ Hz, 2H), 7.54 – 7.47 (m, 4H), 7.43 – 7.37 (m, 1H), 7.37 – 7.31 (m, 5H).

^{13}C NMR (126 MHz, CDCl_3) δ 153.8, 153.7 (d, $J = 18.1$ Hz), 151.6 (d, $J = 18.1$ Hz), 138.7, 129.9, 129.3, 128.5, 114.9 (dd, $J = 13.1$, 6.1 Hz).

6,7-Dichloro-2,3-diphenylquinoxaline (5ha)¹¹

⁶ Z. Zhang, Y. Zheng, Z. Sun, Z. Dai, Z. Tang, J. Ma and C. Ma, *Adv. Synth. Catal.*, 2017, **359**, 2259-2268.

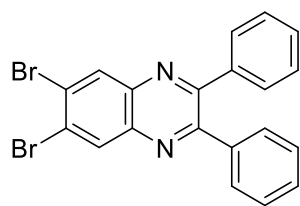


White solid (234 mg, 67%).

^1H NMR (500 MHz, CDCl_3) δ 8.29 (s, 2H), 7.50 (d, $J = 6.9$ Hz, 4H), 7.42 – 7.37 (m, 2H), 7.37 – 7.31 (m, 4H).

^{13}C NMR (126 MHz, CDCl_3) δ 154.6, 140.1, 138.5, 134.6, 129.9 (8C), 129.4, 128.5.

6,7-Dibromo-2,3-diphenylquinoxaline (5ia)⁷

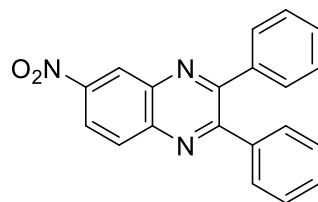


White solid (284 mg, 65%).

^1H NMR (500 MHz, CDCl_3) δ 8.49 (s, 2H), 7.51 (d, $J = 1.2$ Hz, 4H), 7.41 – 7.37 (m, 2H), 7.34 (dd, $J = 8.2, 6.5$ Hz, 4H).

^{13}C NMR (126 MHz, CDCl_3) δ 154.7, 140.6, 138.5, 133.4, 129.9, 129.5, 128.5, 126.6.

6-Nitro-2,3-diphenylquinoxaline (5ja)⁸



⁷ Y. He, Y. Li, H. Su, Y. Si, Y. Liu, Q. Peng, J. He, H. Hou and K. Li, *Mater. Chem. Front.*, 2019, 3, 50-56.

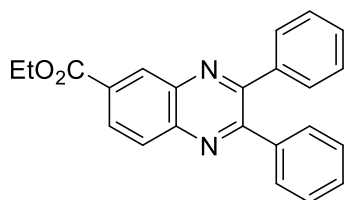
⁸ F. Lassagne, J. M. Sims, W. Erb, O. Mongin, N. Richy, N. El Osmani, Z. Fajloun, L. Picot, V. Thiery, T. Robert, S. Bach, V. Dorcet, T. Roisnel and F. Mongin, *Eur. J. Org. Chem.*, 2021, 2756-2763.

White solid (212 mg, 65%).

^1H NMR (500 MHz, CDCl_3) δ 8.18 (dd, $J = 9.3, 5.8$ Hz, 1H), 7.80 (dt, $J = 9.5, 2.4$ Hz, 1H), 7.60 – 7.54 (m, 1H), 7.51 (t, $J = 6.3$ Hz, 4H), 7.41 – 7.31 (m, 6H).

^{13}C NMR (126 MHz, CDCl_3) δ 156.5, 155.9, 148.1, 143.8, 140.1, 138.3, 138.2, 130.9, 130.1, 130.0, 129.9, 129.8, 128.6, 125.8, 123.5.

Ethyl 2,3-diphenylquinoxaline-6-carboxylate (5ka)⁹

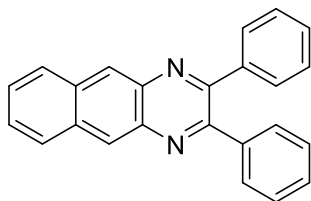


White solid (283 mg, 80%).

^1H NMR (500 MHz, CDCl_3) δ 8.97 (d, $J = 2.0$ Hz, 1H), 8.43 (dd, $J = 8.7, 1.8$ Hz, 1H), 8.26 (d, $J = 8.7$ Hz, 1H), 7.60 (dd, $J = 7.4, 5.4$ Hz, 4H), 7.42 (dt, $J = 14.4, 7.1$ Hz, 6H), 4.53 (q, $J = 7.1$ Hz, 2H), 1.52 (t, $J = 7.1$ Hz, 3H).

^{13}C NMR (75 MHz, CDCl_3) δ 165.8, 155.1, 154.4, 143.2, 140.4, 138.7, 131.8, 131.6, 129.9, 129.8, 129.5, 129.4, 129.3, 129.1, 128.3, 61.6, 14.3.

2,3-Diphenylbenzo[g]quinoxaline (5la)⁴



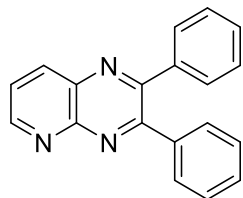
White solid (186 mg, 56%).

⁹ R. Mirzazadeh, M. S. Asgari, E. Barzegari, K. Pedrood, M. Mohammadi-Khanaposhtani, M. Sherafati, B. Larijani, H. Rastegar, H. Rahmani, M. Mahdavi, P. Taslimi and E. M. U. I. Gulçin, *Archiv Pharm.*, 2021, **354**, 2000471.

^1H NMR (500 MHz, CDCl_3) δ 8.75 (s, 2H), 8.12 (dt, $J = 6.8, 3.3$ Hz, 2H), 7.57 (dd, $J = 7.3, 2.2$ Hz, 6H), 7.40 – 7.33 (m, 6H).

^{13}C NMR (126 MHz, CDCl_3) δ 154.3, 139.3, 138.1, 134.2, 130.0, 129.1, 128.7, 128.4, 127.7, 126.9.

2,3-Diphenylpyrido[2,3-b]pyrazine (5ma)¹⁰

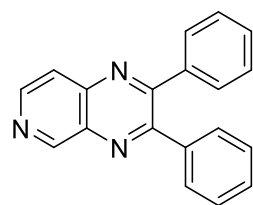


White solid (232 mg, 82%).

^1H NMR (500 MHz, CDCl_3) δ 9.21 (dd, $J = 4.2, 1.8$ Hz, 1H), 8.56 (dd, $J = 8.4, 1.8$ Hz, 1H), 7.76 (dd, $J = 8.3, 4.2$ Hz, 1H), 7.70 – 7.64 (m, 2H), 7.63 – 7.53 (m, 2H), 7.47 – 7.35 (m, 7H).

^{13}C NMR (75 MHz, CDCl_3) δ 154.1, 138.1, 130.3, 129.8, 129.4, 129.3, 128.4, 128.1, 125.2.

2,3-Diphenylpyrido[3,4-b]pyrazine (5na)¹¹



Yellow solid (212 mg, 75%)

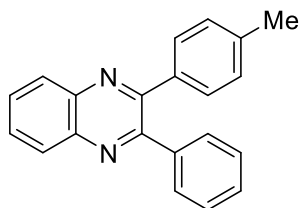
^1H NMR (500 MHz, CDCl_3) δ 9.65 (s, 1H), 8.87 (d, $J = 5.7$ Hz, 2H), 8.04 (d, $J = 5.7$ Hz, 2H), 7.66 – 7.55 (m, 7H), 7.48 – 7.43 (m, 4H), 7.42 – 7.37 (m, 9H).

^{13}C NMR (75 MHz, CDCl_3) δ 157.9, 155.4, 154.5, 147.3, 143.6, 138.3, 136.3, 129.9, 129.8, 129.7, 129.4, 128.7, 128.4, 121.3.

¹⁰ X. Chen, H. Zhao, C. Chen, H. Jiang and M., Zhang, *Chem. Commun.*, 2018, **54**, 9087-9090.

¹¹ Q. Wang, B. Zhu, X. Zhang, G. Shi, J. Liu and Q. Xu, *Asian J. Org. Chem.*, 2022, DOI: 10.1002/ajoc.202200056

2-Phenyl-3-(p-tolyl)quinoxaline (5ab)⁴

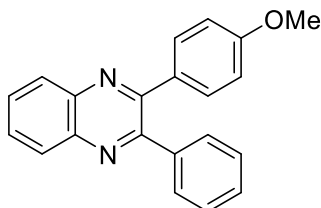


White solid (254 mg, 86%).

¹H NMR (500 MHz, CDCl₃) δ 8.20 – 8.13 (m, 2H), 7.80 – 7.72 (m, 2H), 7.54 (d, *J* = 6.2 Hz, 2H), 7.42 (d, *J* = 7.9 Hz, 2H), 7.38 – 7.32 (m, 3H), 7.14 (d, *J* = 7.8 Hz, 2H), 2.37 (s, 3H).

¹³C NMR (126 MHz, CDCl₃) δ 153.6, 141.4, 141.2, 139.4, 139.0, 136.3, 130.0, 129.9, 129.8, 129.7, 129.3, 129.1, 128.9, 128.4, 21.5.

2-(4-Methoxyphenyl)-3-phenylquinoxaline (5ac)⁴

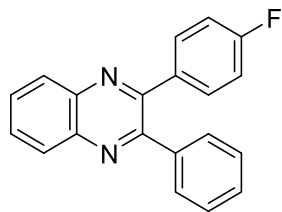


White solid (271 mg, 87%).

¹H NMR (500 MHz, CDCl₃) δ 8.18 – 8.12 (m, 2H), 7.79 – 7.71 (m, 2H), 7.54 (dd, *J* = 7.3, 2.3 Hz, 2H), 7.48 (d, *J* = 6.7 Hz, 2H), 7.37 (d, *J* = 4.5 Hz, 3H), 6.86 (d, *J* = 8.8 Hz, 2H), 3.82 (s, 3H).

¹³C NMR (126 MHz, CDCl₃) δ 160.4, 153.6, 153.2, 141.4, 141.1, 139.5, 131.6, 131.5, 130.0, 129.9, 129.7, 129.3, 129.2, 128.9, 128.5, 113.9, 55.4.

2-(4-Fluorophenyl)-3-phenylquinoxaline (5ad)⁴

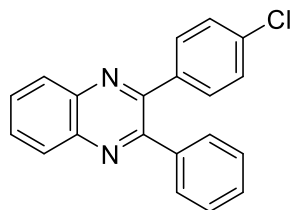


White solid (240 mg, 80%).

^1H NMR (500 MHz, CDCl_3) δ 8.21 – 8.14 (m, 2H), 7.78 (dd, $J = 6.4, 3.4$ Hz, 2H), 7.53 – 7.49 (m, 4H), 7.42 – 7.32 (m, 3H), 7.03 (t, $J = 8.6$ Hz, 2H).

^{13}C NMR (126 MHz, CDCl_3) δ 163.3 (d, $J = 249.4$ Hz), 153.4, 152.5, 141.3 (d, $J = 6.7$ Hz), 139.1, 135.3, 135.2, 132.0 (d, $J = 8.4$ Hz), 130.2, 130.1, 129.9, 129.4, 129.3, 129.1, 128.5, 115.5 (d, $J = 21.6$ Hz).

2-(4-Chlorophenyl)-3-phenylquinoxaline (5ae)⁴

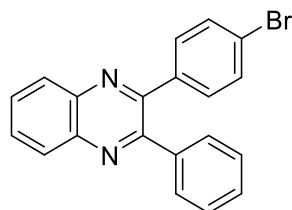


White solid (262 mg, 83%).

^1H NMR (500 MHz, CDCl_3) δ 8.2 (dt, $J = 7.2, 3.7$ Hz, 2H), 7.8 (dd, $J = 6.5, 3.4$ Hz, 2H), 7.6 – 7.5 (m, 2H), 7.5 (d, $J = 8.2$ Hz, 2H), 7.4 – 7.3 (m, 3H), 7.3 (d, $J = 8.3$ Hz, 2H).

^{13}C NMR (126 MHz, CDCl_3) δ 153.4, 152.3, 141.4, 141.3, 139.0, 137.6, 135.3, 131.4, 130.4, 130.3, 129.9, 129.4, 129.3, 129.1, 128.7, 128.6.

2-(4-Bromophenyl)-3-phenylquinoxaline (5af)⁴



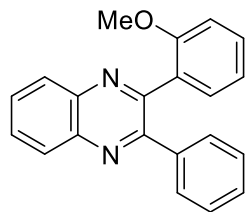
White solid (306 mg, 85%).

^1H NMR (500 MHz, CDCl_3) δ 8.21 – 8.14 (m, 2H), 7.82 – 7.74 (m, 2H), 7.52 (d, $J = 10.5$ Hz, 2H), 7.47 (d, $J = 8.5$ Hz, 2H), 7.44 – 7.33 (m, 5H).

^{13}C NMR (126 MHz, CDCl_3) δ 152.9, 152.3, 141.4, 141.3, 138.9, 138.1, 131.6, 130.4, 130.3, 129.9, 129.4, 129.3, 129.2, 128.7, 123.6.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{20}\text{H}_{14}\text{BrN}_2$, 361.0340. Found: 361.0347.

2-(2-Methoxyphenyl)-3-phenylquinoxaline (5ag)¹²

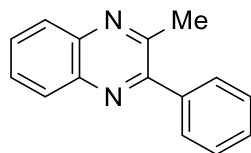


White solid (224 mg, 72%).

^1H NMR (500 MHz, CDCl_3) δ 8.17 (td, $J = 5.4, 2.8$ Hz, 2H), 7.76 – 7.70 (m, 2H), 7.64 (dd, $J = 7.5, 1.8$ Hz, 1H), 7.47 (dd, $J = 7.5, 2.0$ Hz, 2H), 7.35 (td, $J = 7.9, 1.8$ Hz, 1H), 7.30 – 7.20 (m, 3H), 7.11 (t, $J = 7.5$ Hz, 1H), 6.67 (d, $J = 8.3$ Hz, 1H), 3.18 (s, 3H).

^{13}C NMR (126 MHz, CDCl_3) δ 156.5, 154.9, 152.4, 141.5, 141.4, 139.7, 131.1, 130.8, 129.9, 129.6, 129.4, 129.3, 128.9, 128.7, 128.5, 127.8, 121.4, 111.2, 54.8.

2-Methyl-3-phenylquinoxaline (5ah)¹



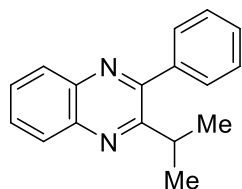
White solid (114 mg, 52%).

¹² C. Chen, W. Hu, M. Liu, P. Yan, J. Wang and M. Chung, *Tetrahedron*, 2013, **69**, 9735-9741.

^1H NMR (500 MHz, CDCl_3) δ 8.17 – 8.11 (m, 1H), 8.09 – 8.04 (m, 1H), 7.73 (td, $J = 7.3, 1.7$ Hz, 2H), 7.69 – 7.64 (m, 2H), 7.58 – 7.48 (m, 3H), 2.79 (s, 3H).

^{13}C NMR (126 MHz, CDCl_3) δ 154.9, 152.5, 141.2, 141.0, 139.0, 129.7, 129.2, 129.2, 129.2, 129.0, 128.9, 128.8, 128.7, 128.5, 128.3, 128.0, 24.4.

2-Isopropyl-3-phenylquinoxaline (5ai)¹³

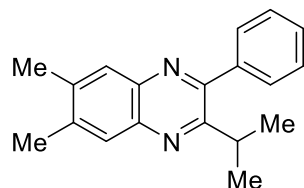


White solid (139 mg, 56%).

^1H NMR (500 MHz, CDCl_3) δ 8.10 (d, $J = 8.2$ Hz, 2H), 7.77 – 7.67 (m, 2H), 7.58 (dd, $J = 7.9, 1.7$ Hz, 2H), 7.55 – 7.45 (m, 3H), 3.56 – 3.45 (m, 1H), 1.32 (d, $J = 6.7$ Hz, 6H).

^{13}C NMR (126 MHz, CDCl_3) δ 160.9, 154.8, 141.9, 140.7, 139.5, 129.6, 129.3, 129.2, 129.0, 128.9, 128.8, 128.7, 32.2, 22.4.

2-Isopropyl-6,7-dimethyl-3-phenylquinoxaline (5bi)¹³



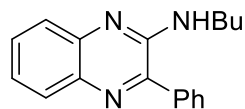
White solid (160 mg, 58%).

^1H NMR (500 MHz, CDCl_3) δ 7.85 (d, $J = 11.5$ Hz, 2H), 7.59 – 7.54 (m, 2H), 7.54 – 7.43 (m, 3H), 3.50 – 3.40 (m, 1H), 2.50 (s, 3H), 2.48 (s, 3H), 1.30 (d, $J = 6.7$ Hz, 6H).

^{13}C NMR (126 MHz, CDCl_3) δ 159.8, 153.8, 140.9, 140.0, 139.8, 139.7, 139.6, 129.0, 128.6, 128.5, 128.3, 128.0, 32.0, 22.5, 20.5, 20.4.

¹³ C. S. Cho, W. X. Ren and S. C. Shim, *Tetrahedron Lett.*, 2007, **48**, 4665-4667.

***N*-Butyl-3-phenylquinoxalin-2-amine (6a)**



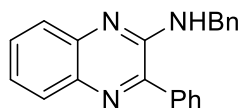
Pale yellow viscous liquid (216 mg, 78%).

^1H NMR (500 MHz, CDCl_3) δ 7.90 (dd, $J = 8.1, 1.4$ Hz, 1H), 7.74 (dd, $J = 7.8, 1.3$ Hz, 1H), 7.72 – 7.67 (m, 2H), 7.58 – 7.51 (m, 4H), 7.37 (ddd, $J = 8.3, 6.9, 1.4$ Hz, 1H), 5.09 (t, $J = 5.6$ Hz, 1H), 3.55 (td, $J = 7.2, 5.4$ Hz, 2H), 1.61 (tt, $J = 7.8, 6.7$ Hz, 2H), 1.40 (h, $J = 7.4$ Hz, 2H), 0.95 (t, $J = 7.4$ Hz, 3H).

^{13}C NMR (126 MHz, CDCl_3) δ 150.2, 146.7, 136.9, 136.9, 129.7, 129.3, 128.9, 128.4, 125.9, 124.3, 41.1, 31.4, 20.3, 13.9.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{18}\text{H}_{20}\text{N}_3$, 278.1657. Found: 278.1661.

***N*-Benzyl-3-phenylquinoxalin-2-amine (6b)¹⁴**



Pale yellow viscous liquid (258 mg, 83%).

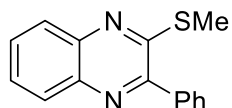
^1H NMR (500 MHz, CDCl_3) δ 7.97 (dd, $J = 8.2, 1.4$ Hz, 1H), 7.80 (dd, $J = 8.4, 1.4$ Hz, 1H), 7.77 – 7.71 (m, 2H), 7.62 (ddd, $J = 8.4, 6.9, 1.5$ Hz, 1H), 7.58 – 7.49 (m, 3H), 7.48 – 7.34 (m, 5H), 7.31 – 7.24 (m, 1H), 5.47 (s, 1H), 4.82 (d, $J = 5.5$ Hz, 2H).

^{13}C NMR (126 MHz, CDCl_3) δ 149.9, 146.5, 141.6, 138.9, 137.2, 136.7, 129.8, 129.7, 129.4, 128.9, 128.7, 128.4, 127.8, 127.4, 126.2, 124.6, 45.4.

2-(Methylthio)-3-phenylquinoxaline (7)¹⁵

¹⁴ K. R. Kiran, T. R. Swaroop, C. Santhosh, K. S. Rangappa, and Sadashiva, M. P. *Chem. Select*, 2021, **6**, 7262-7265

¹⁵ K. R. Kiran, T. R. Swaroop, K. P. Sukrutha, J. B. Shruthi, S. M. Anil, K. S. Rangappa and M. P. Sadashiva, *Synthesis*, 2019, **51**, 4205-4214.

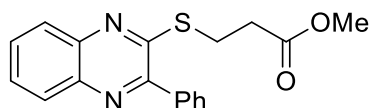


Brown solid (213 mg, 85%).

^1H NMR (500 MHz, CDCl_3) δ 8.06 (dd, $J = 8.2, 1.4$ Hz, 1H), 7.99 (dd, $J = 8.4, 1.5$ Hz, 1H), 7.78 (ddd, $J = 6.0, 3.5, 1.8$ Hz, 2H), 7.70 (ddd, $J = 8.3, 6.9, 1.5$ Hz, 1H), 7.63 (ddd, $J = 8.3, 7.0, 1.5$ Hz, 1H), 7.56 – 7.41 (m, 3H), 2.65 (s, 3H).

^{13}C NMR (126 MHz, CDCl_3) δ 155.9, 153.5, 141.7, 139.3, 137.4, 129.8, 129.7, 129.3, 129.0, 128.5, 128.1, 127.5, 13.8.

Methyl 3-((3-phenylquinoxalin-2-yl)thio)propanoate (8a)¹⁶

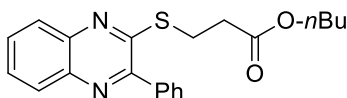


Pale yellow viscous liquid (210 mg, 65%).

^1H NMR (500 MHz, CDCl_3) δ 8.06 (dd, $J = 8.3, 1.5$ Hz, 1H), 7.97 (dd, $J = 8.3, 1.4$ Hz, 1H), 7.79 – 7.74 (m, 2H), 7.70 (ddd, $J = 8.4, 6.9, 1.5$ Hz, 1H), 7.64 (ddd, $J = 8.3, 6.9, 1.5$ Hz, 1H), 7.52 (q, $J = 2.8$ Hz, 3H), 3.71 (s, 3H), 3.54 (t, $J = 7.2$ Hz, 2H), 3.49 (s, 1H), 2.86 (t, $J = 7.2$ Hz, 2H).

^{13}C NMR (126 MHz, CDCl_3) δ 154.6, 153.4, 141.4, 139.4, 137.2, 129.9, 129.8, 129.3, 129.0, 128.5, 128.4, 127.6, 51.8, 33.7, 25.6.

Butyl 3-((3-phenylquinoxalin-2-yl)thio)propanoate (8b)



Pale yellow viscous liquid (249 mg, 68%).

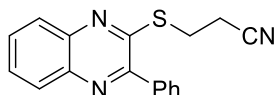
¹⁶ S. M. El Rayes, A. Aboelmagd, M. S. Gomaa, I. A. I. Ali, W. Fathalla, F. H. Pottoo, and F. A. Khan, *ACS Omega*, 2019, 4, 18555-18566.

^1H NMR (500 MHz, CDCl_3) δ 8.06 (d, $J = 8.1$ Hz, 1H), 7.97 (d, $J = 8.1$ Hz, 1H), 7.81 – 7.74 (m, 3H), 7.73 – 7.68 (m, 1H), 7.68 – 7.60 (m, 1H), 7.56 – 7.39 (m, 4H), 4.17 – 4.02 (m, 2H), 3.54 (t, $J = 7.1$ Hz, 2H), 2.85 (t, $J = 7.1$ Hz, 2H), 1.67 – 1.54 (m, 2H), 1.42 – 1.33 (m, 2H), 0.93 (dt, $J = 9.1, 7.4$ Hz, 3H).

^{13}C NMR (126 MHz, CDCl_3) δ 172.1, 154.7, 153.4, 141.4, 139.4, 137.2, 129.9, 129.8, 129.3, 129.0, 128.5, 128.3, 127.6, 77.3, 64.6, 34.0, 30.6, 25.7, 19.1, 13.7.

HRMS m/z : calcd for $[\text{M}+\text{H}]^+$ $\text{C}_{21}\text{H}_{23}\text{N}_2\text{O}_2\text{S}$, 367.1480. Found: 367.1486.

3-((3-Phenylquinoxalin-2-yl)thio)propanenitrile (8c)¹⁶



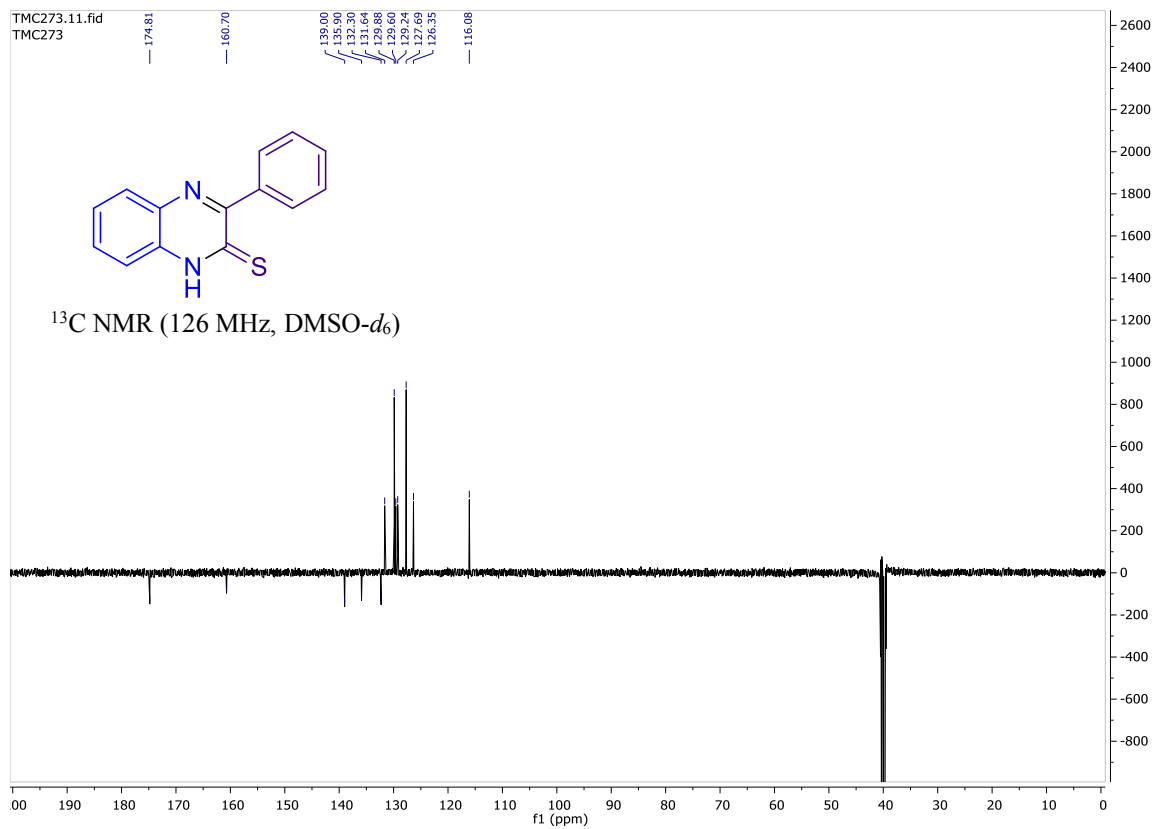
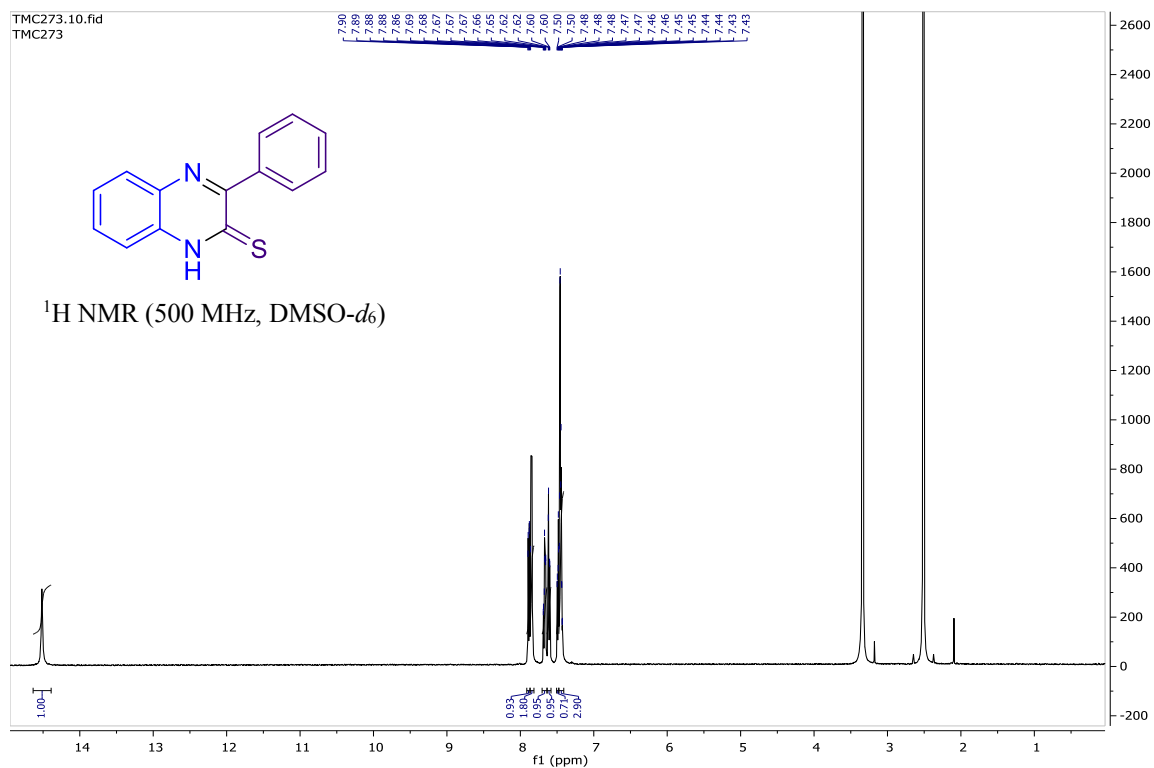
The product was purified by column chromatography (eluent: dichloromethane). White solid (215 mg, 74%).

^1H NMR (500 MHz, CDCl_3) δ 8.09 (dd, $J = 8.2, 1.5$ Hz, 1H), 7.98 (dd, $J = 8.3, 1.5$ Hz, 1H), 7.80 – 7.76 (m, 2H), 7.73 (ddd, $J = 8.4, 6.9, 1.6$ Hz, 1H), 7.67 (ddd, $J = 8.3, 6.9, 1.6$ Hz, 1H), 7.58 – 7.47 (m, 3H), 3.51 (t, $J = 7.1$ Hz, 2H), 2.93 (t, $J = 7.1$ Hz, 2H).

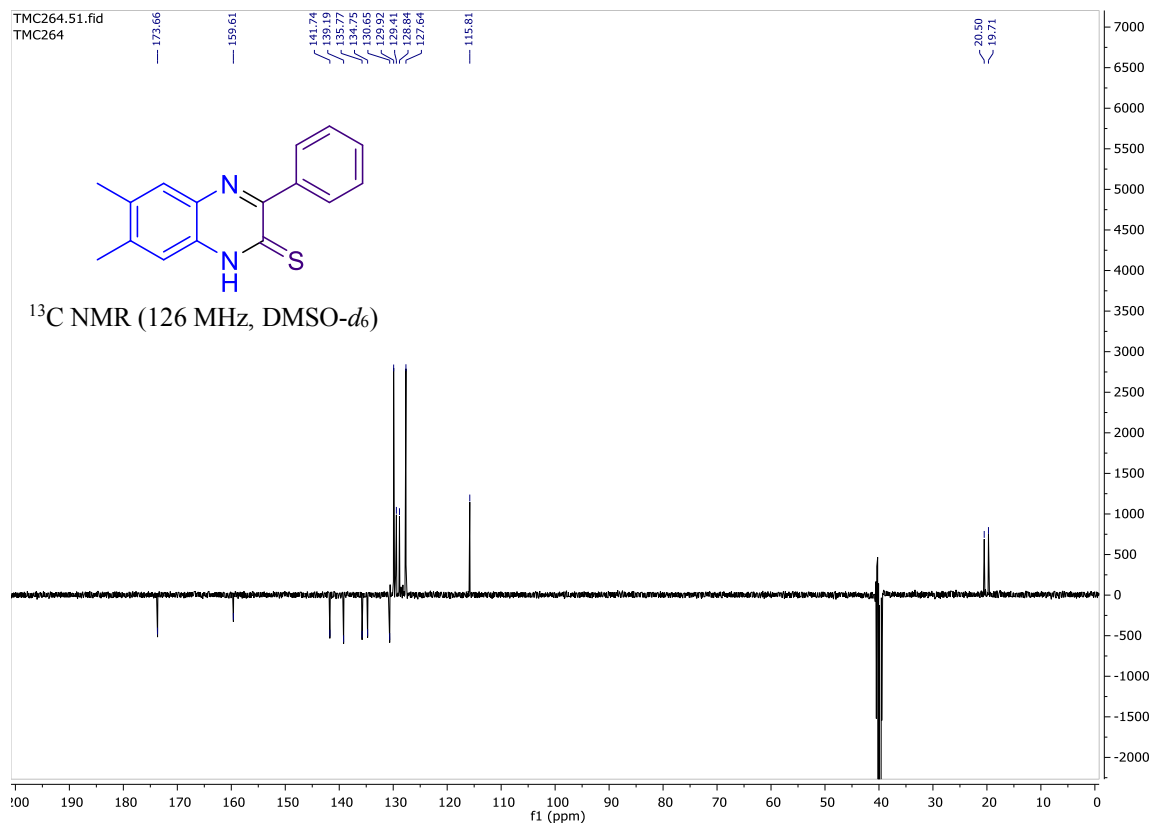
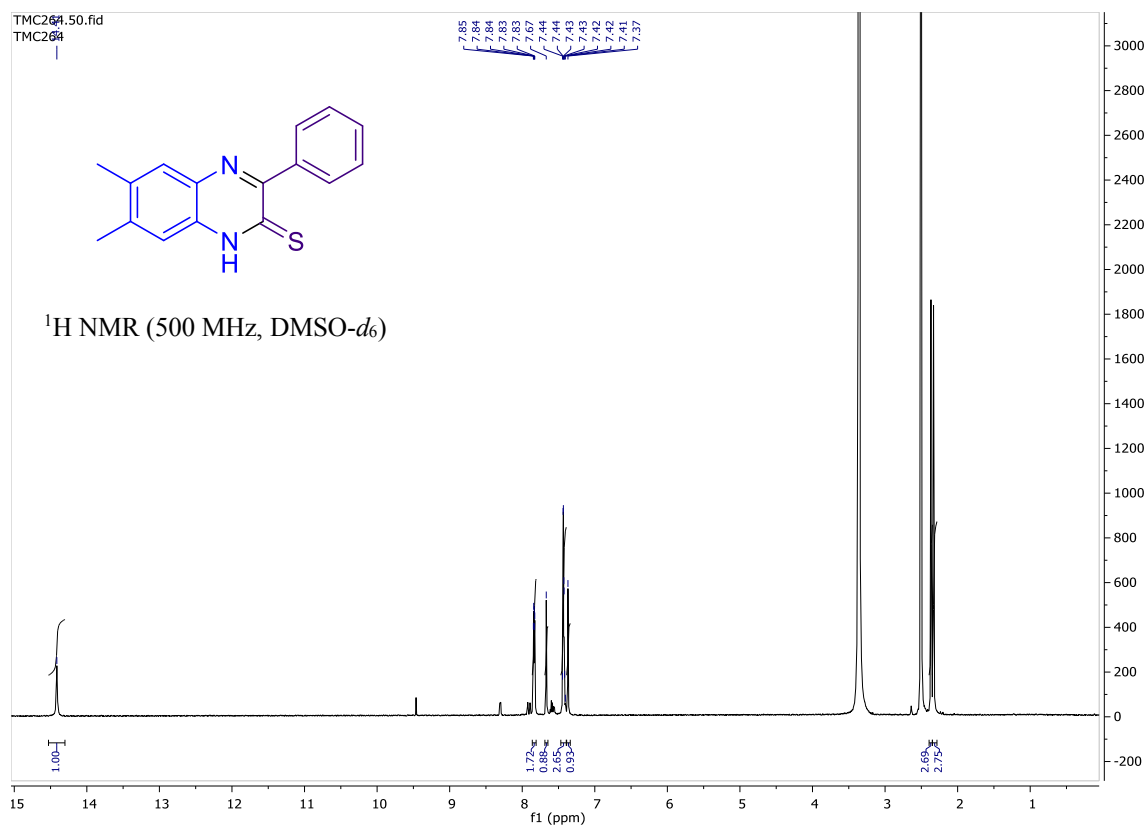
^{13}C NMR (126 MHz, CDCl_3) δ 153.3, 153.2, 141.2, 139.7, 136.8, 130.2, 130.0, 129.4, 129.0, 128.9, 128.8, 128.6, 127.5, 118.4, 26.2, 18.0.

Copies of ^1H and ^{13}C spectra of quinoxaline 3, 5, 6, 7 and 8

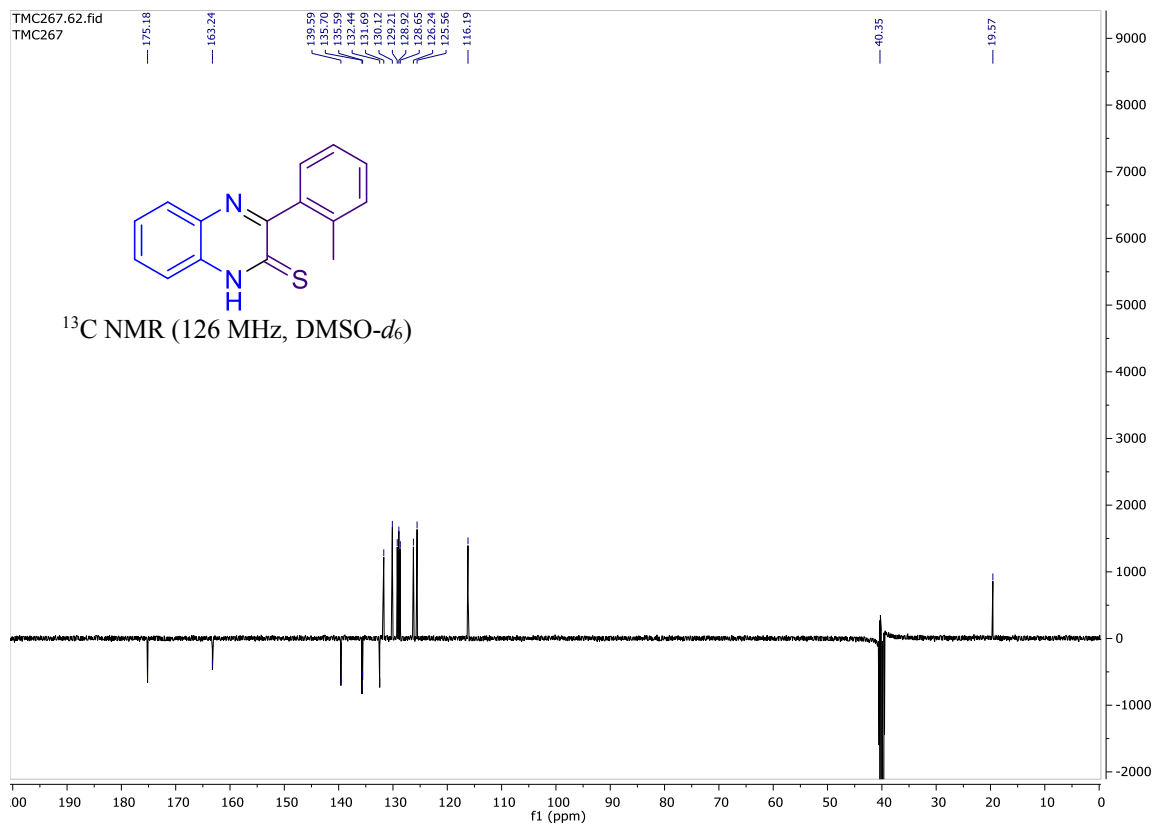
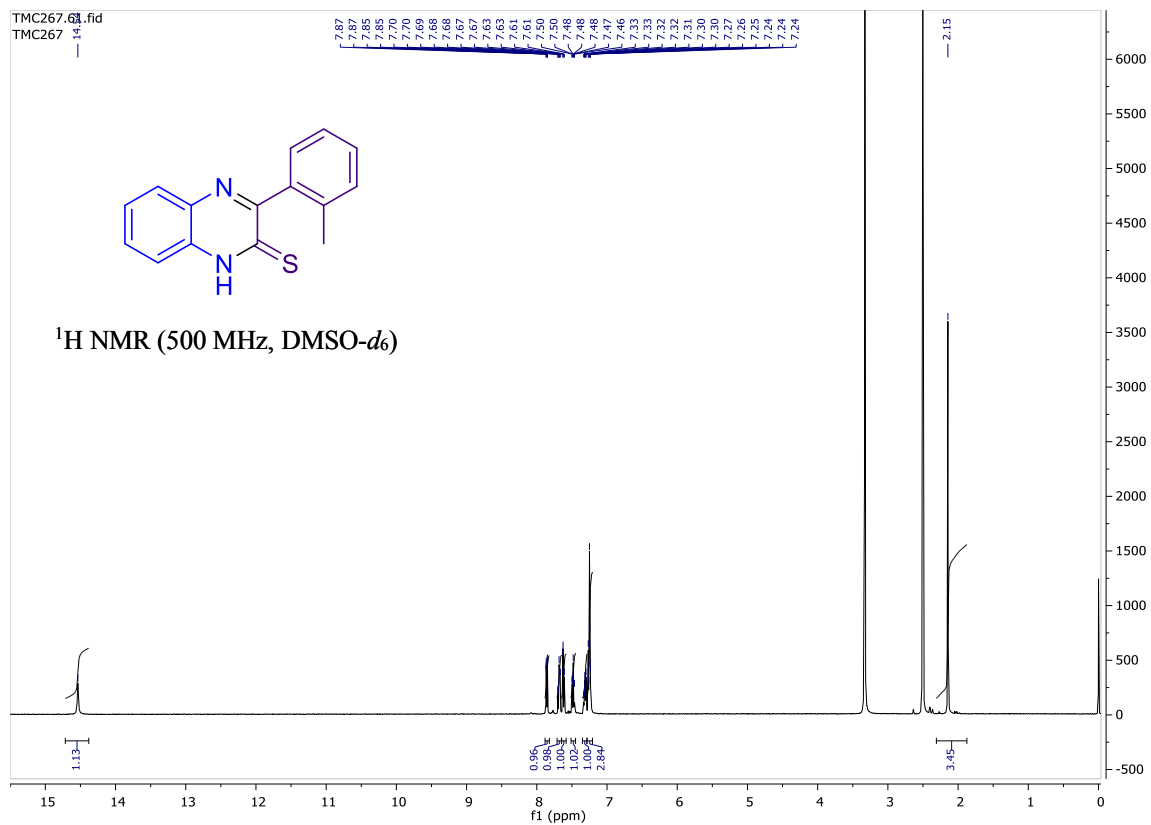
3-Phenylquinoxaline-2(1H)-thione (3aa)



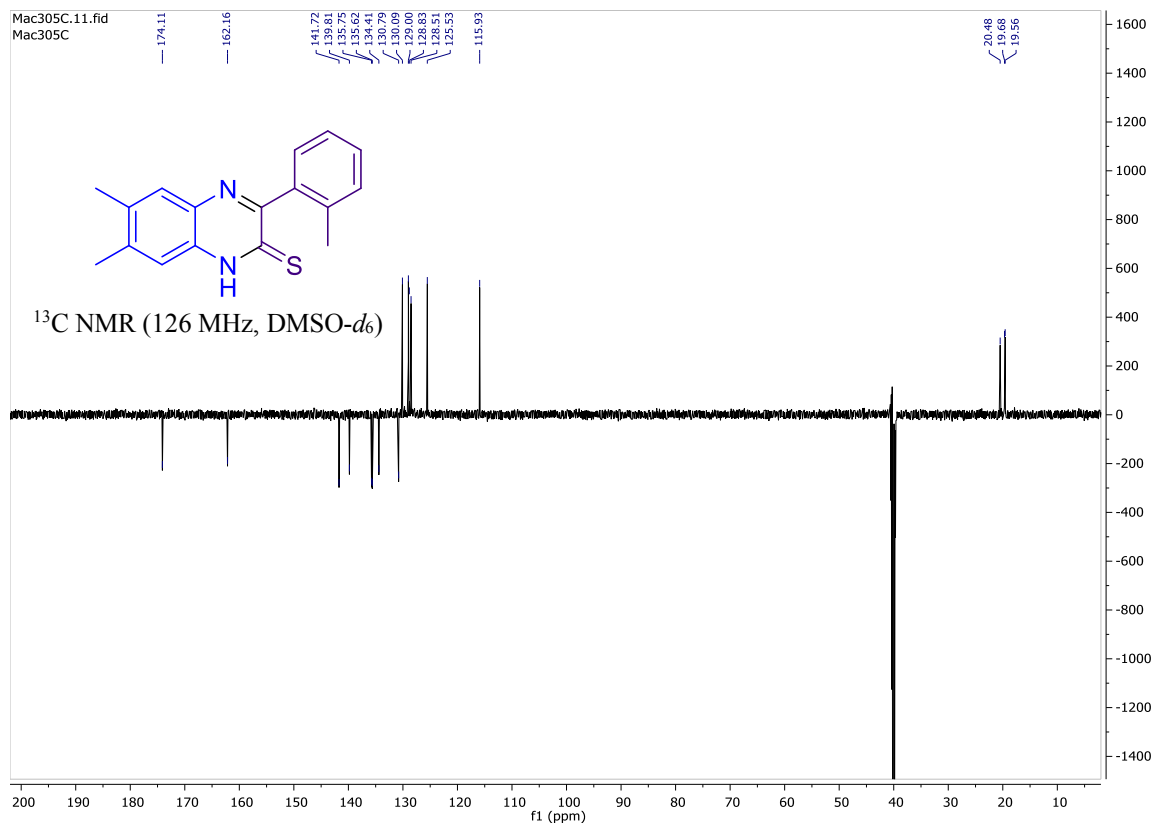
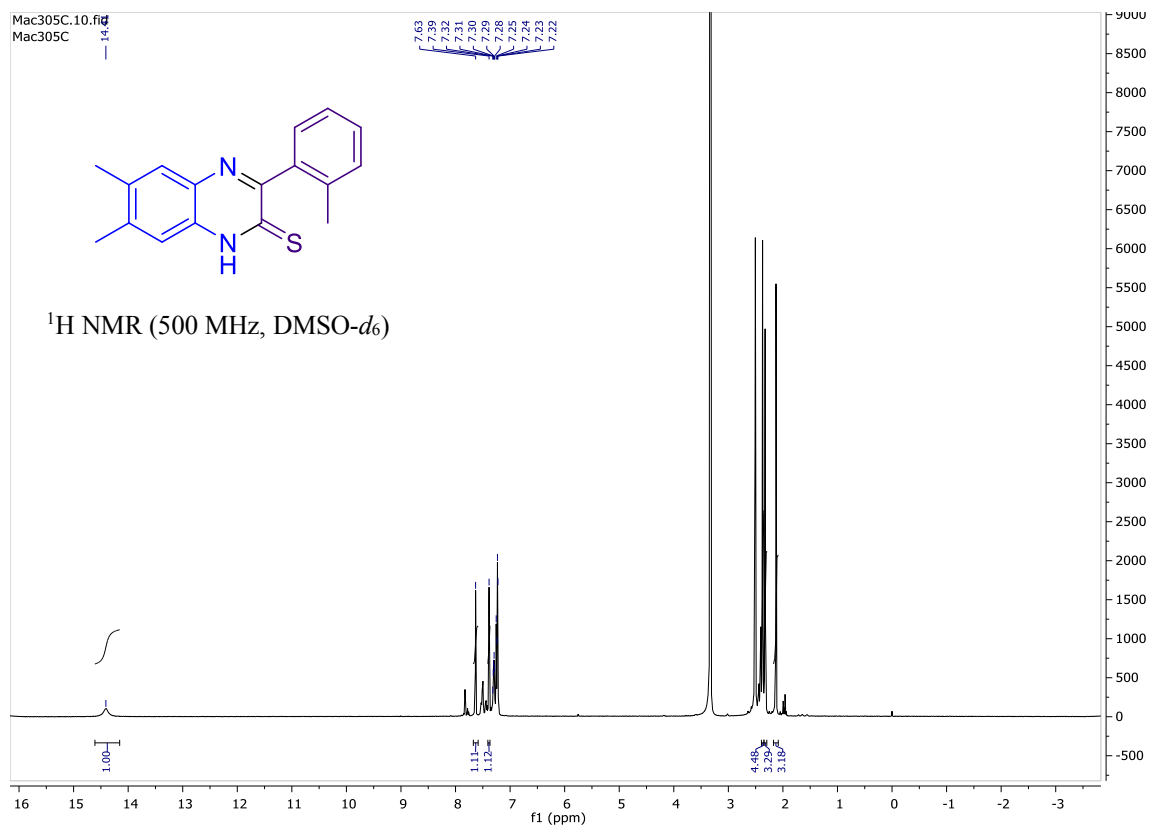
6,7-Dimethyl-3-phenylquinoxaline-2(1H)-thione (3ba)



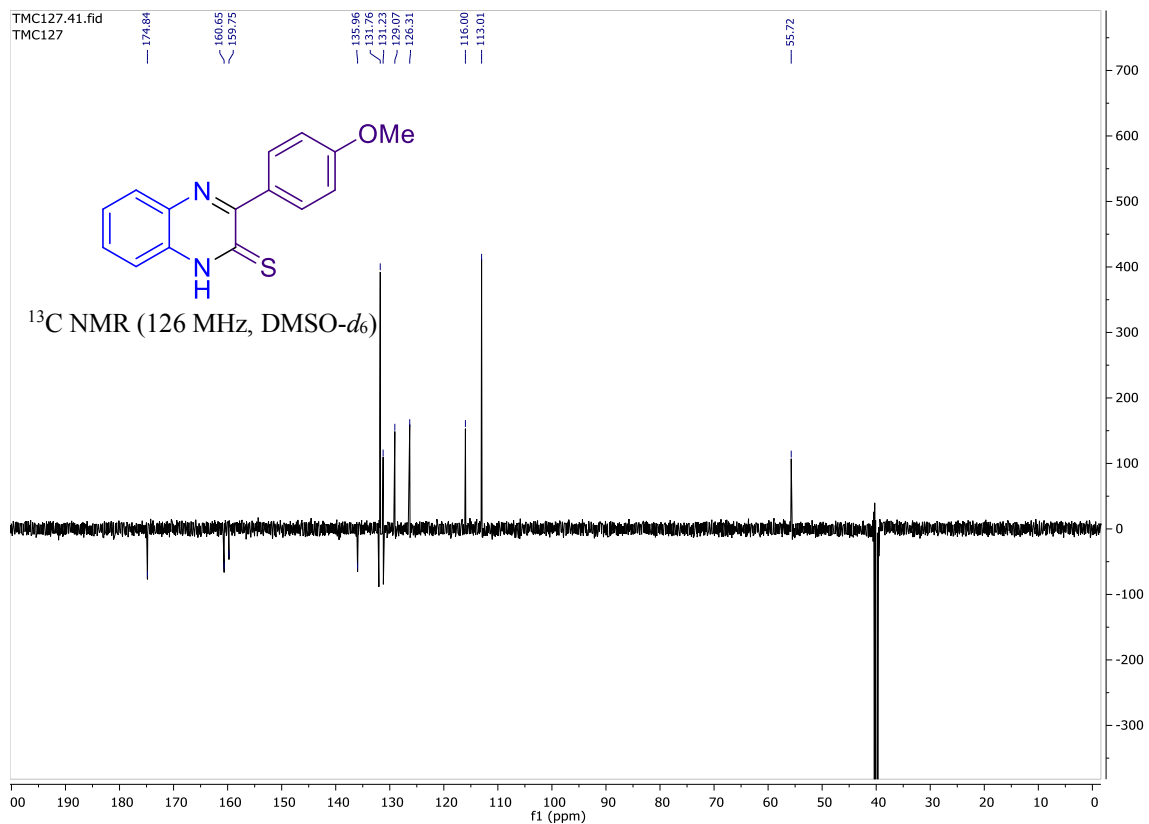
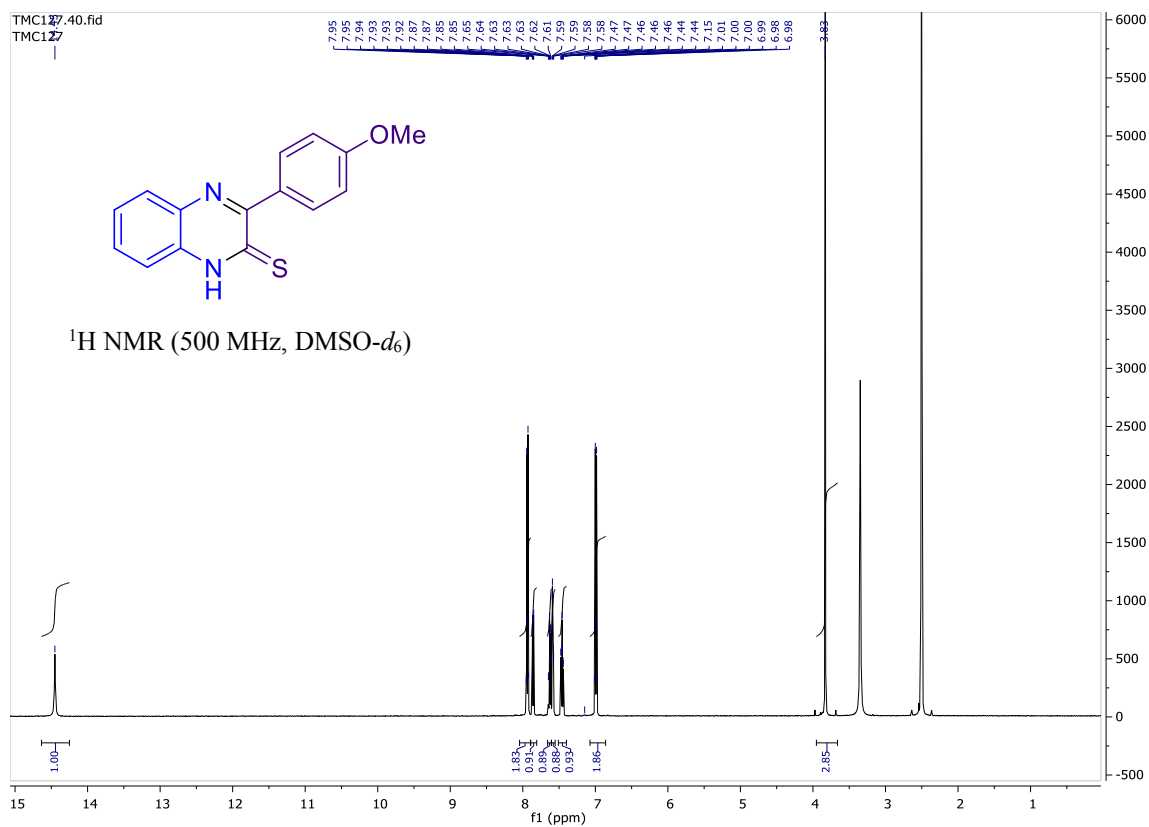
3-(*o*-Tolyl)quinoxaline-2(1*H*)-thione (3ab)



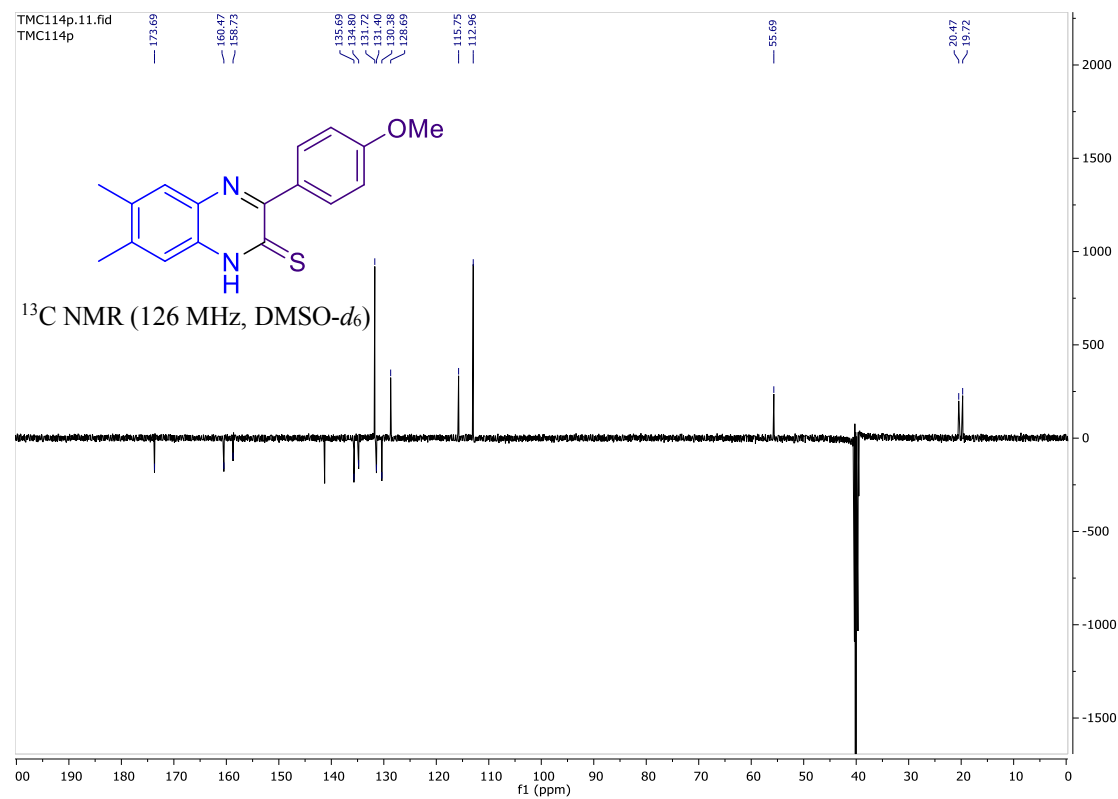
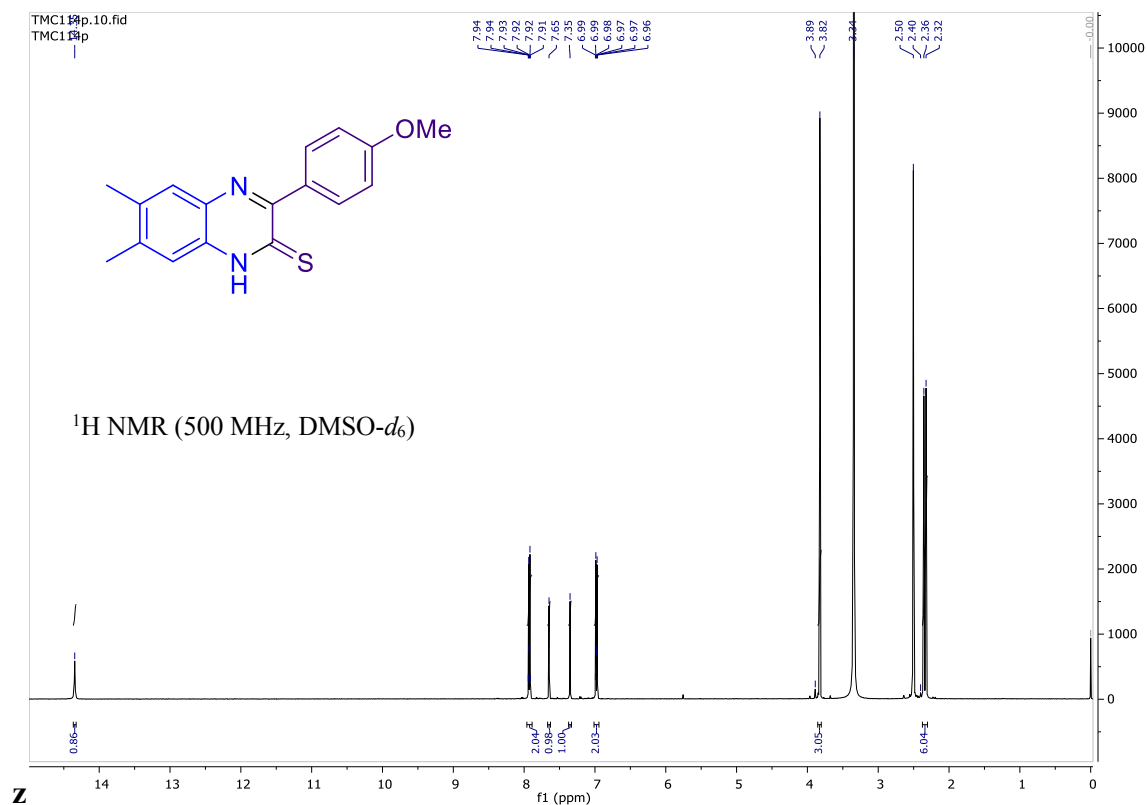
6,7-Dimethyl-3-(*o*-tolyl)quinoxaline-2(1*H*)-thione (3bb)



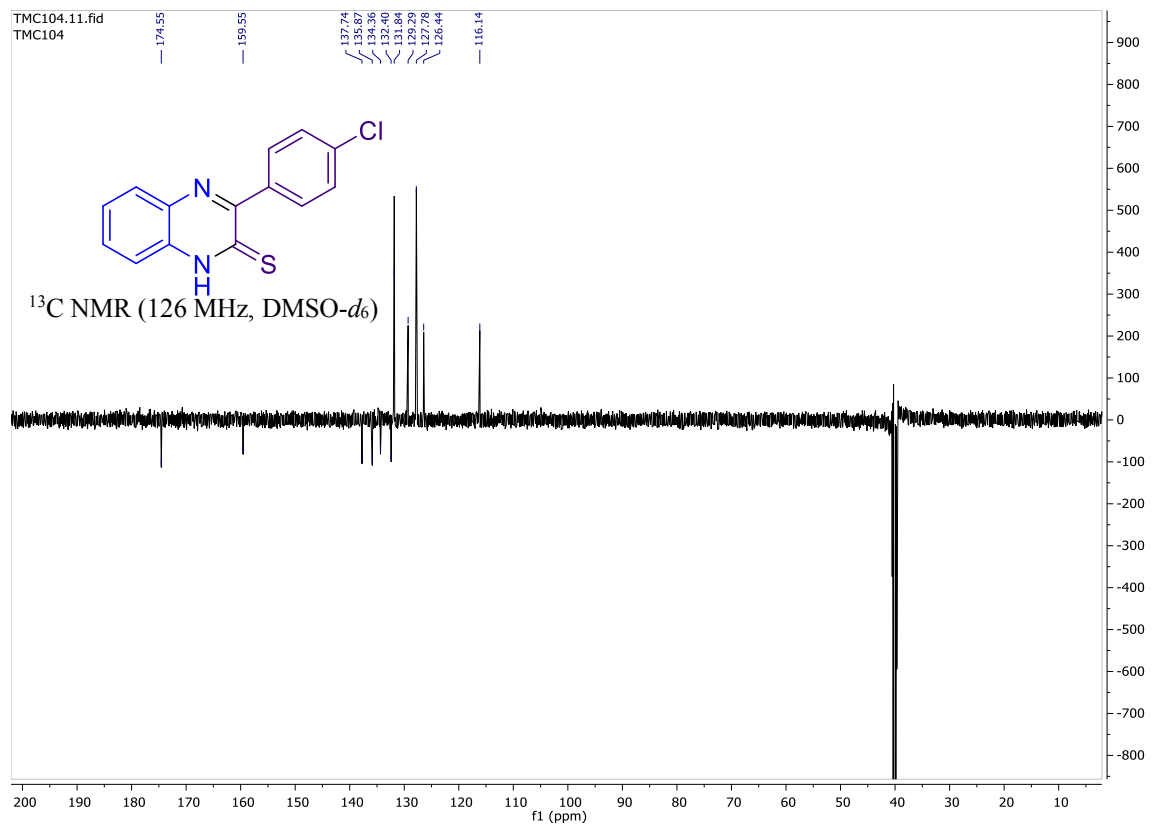
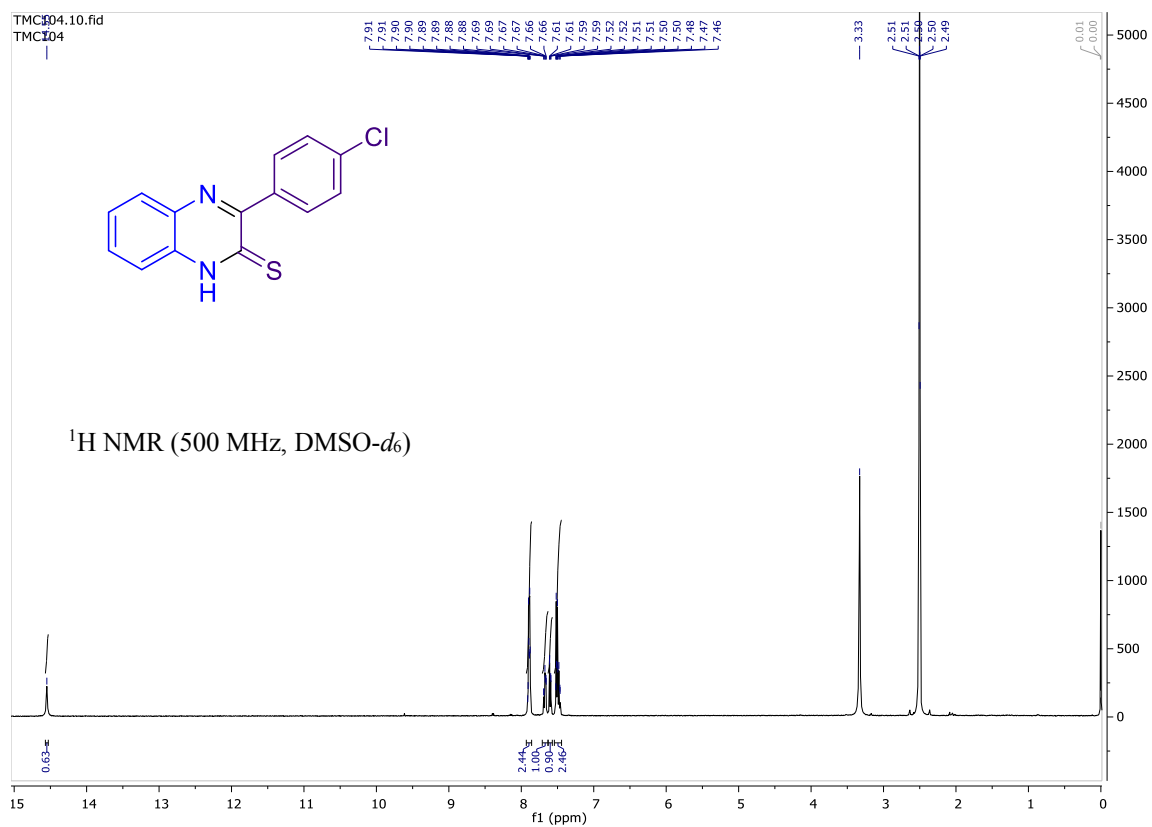
3-(4-Methoxyphenyl)quinoxaline-2(1H)-thione (3ac)



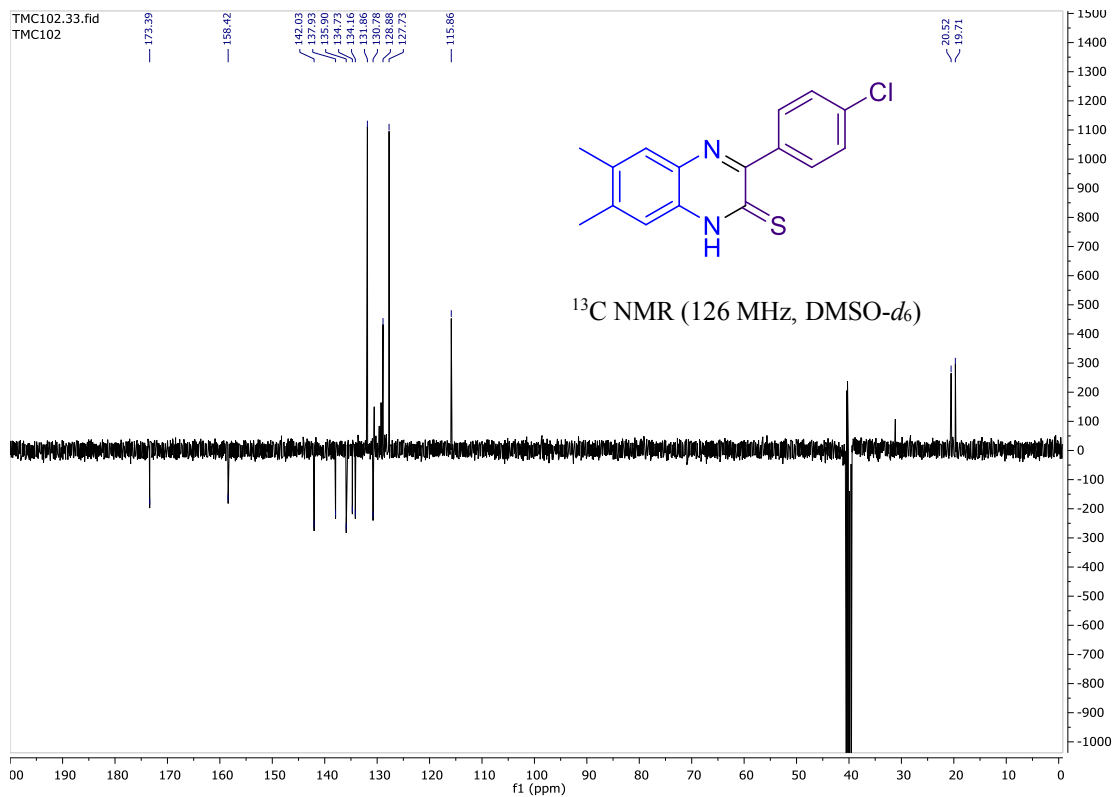
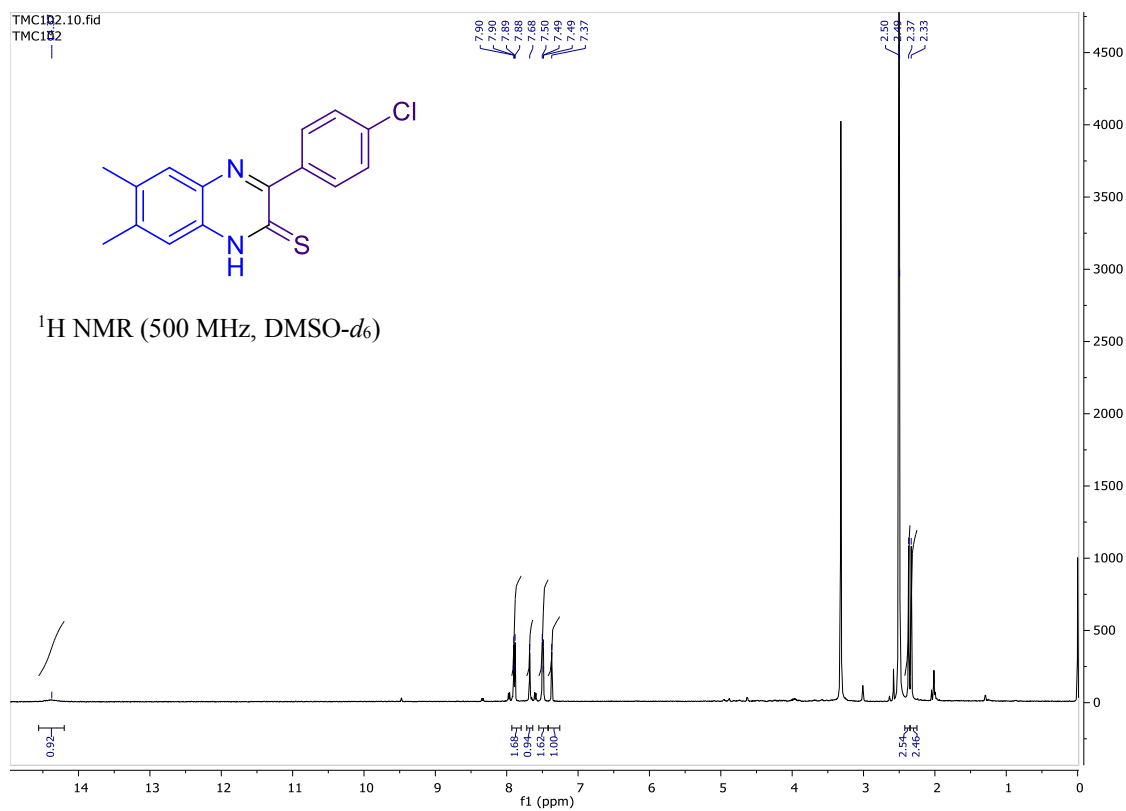
3-(4-Methoxyphenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bc)



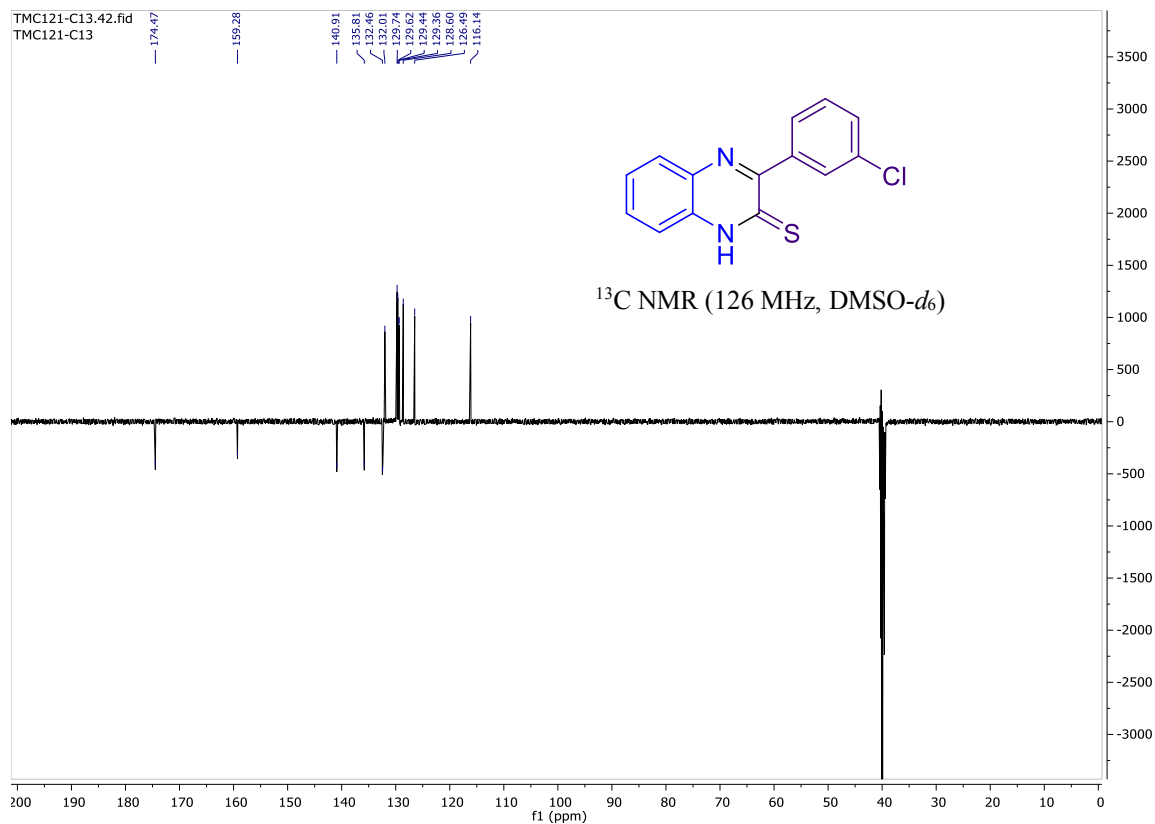
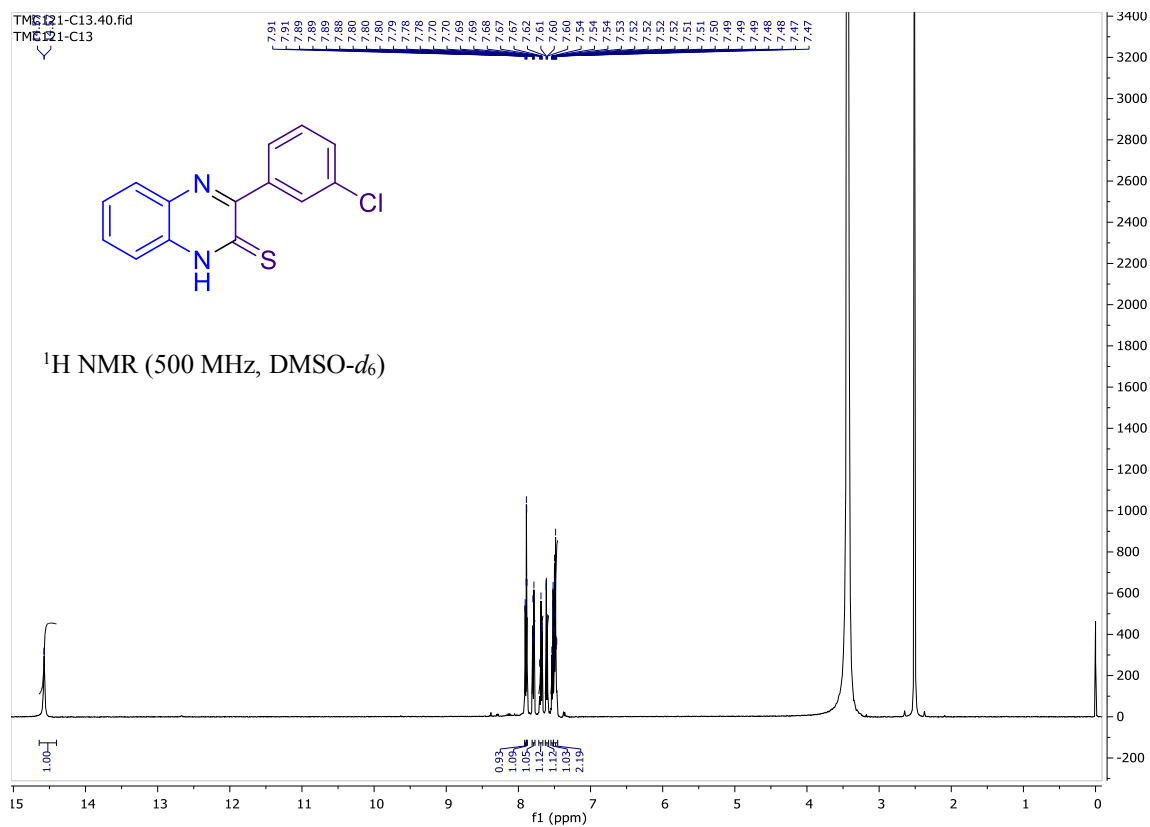
3-(4-Chlorophenyl)quinoxaline-2(1H)-thione (3ad)



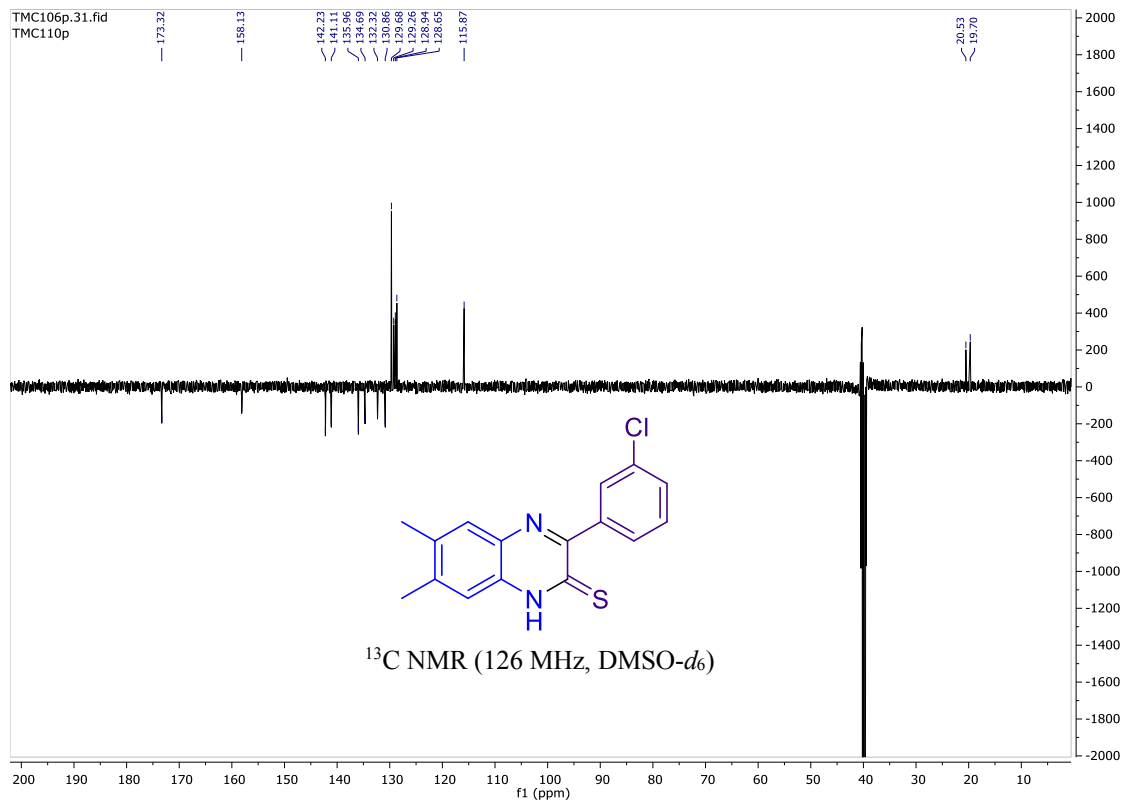
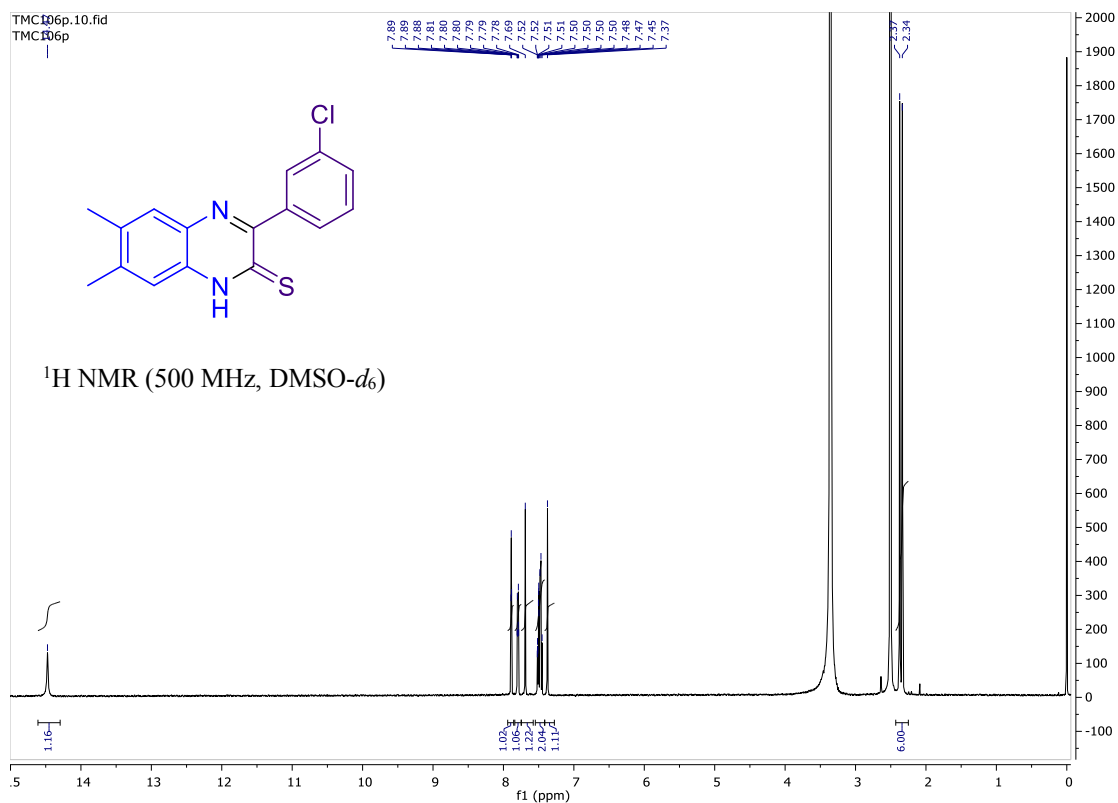
3-(4-Chlorophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bd)



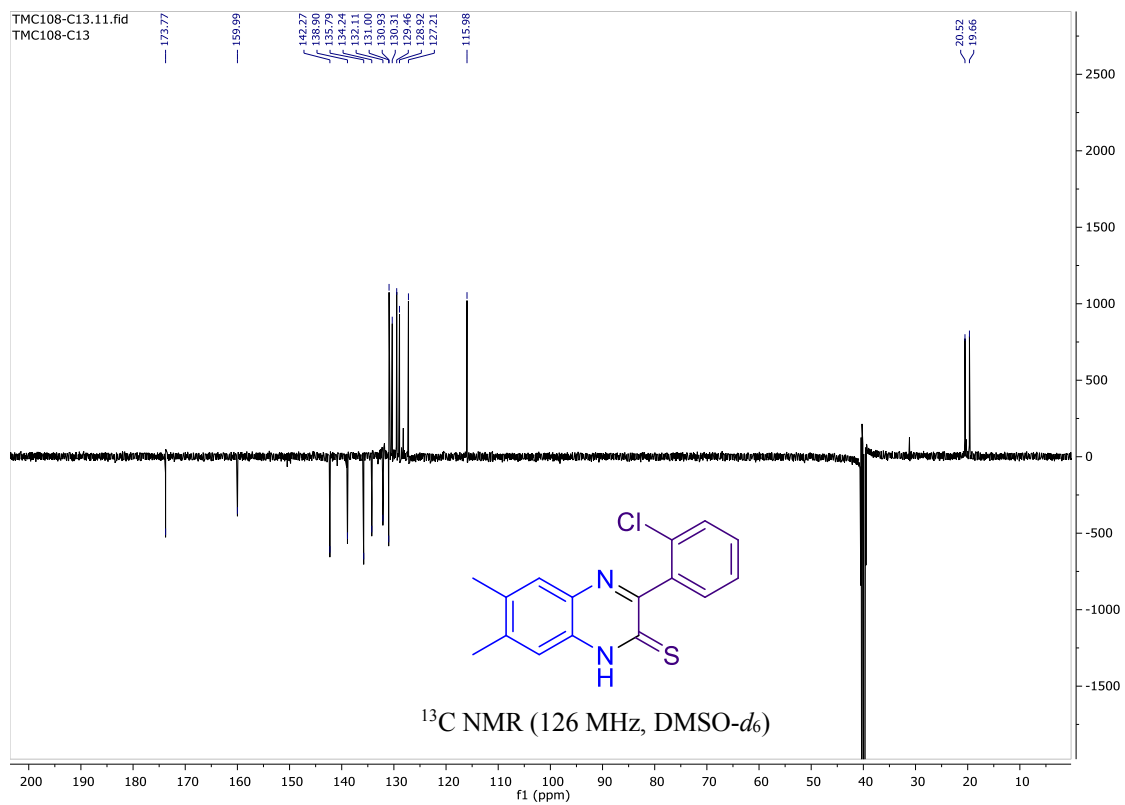
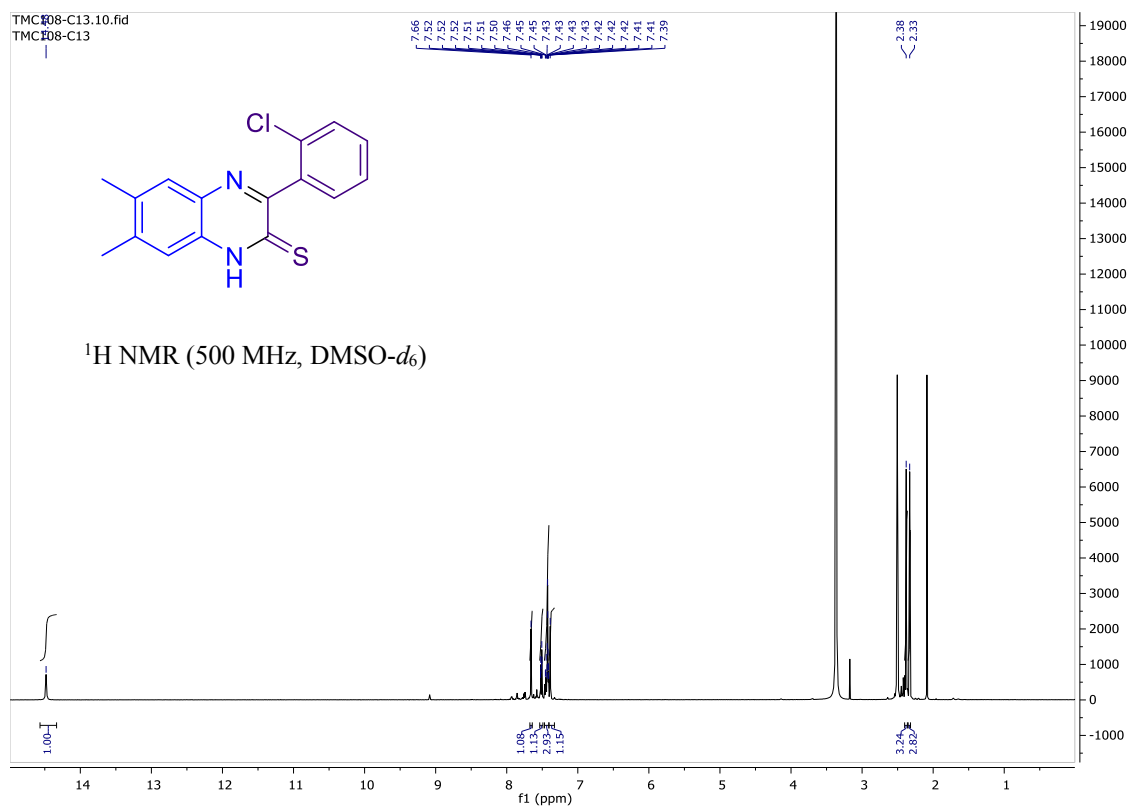
3-(3-Chlorophenyl)quinoxaline-2(1H)-thione (3ae)



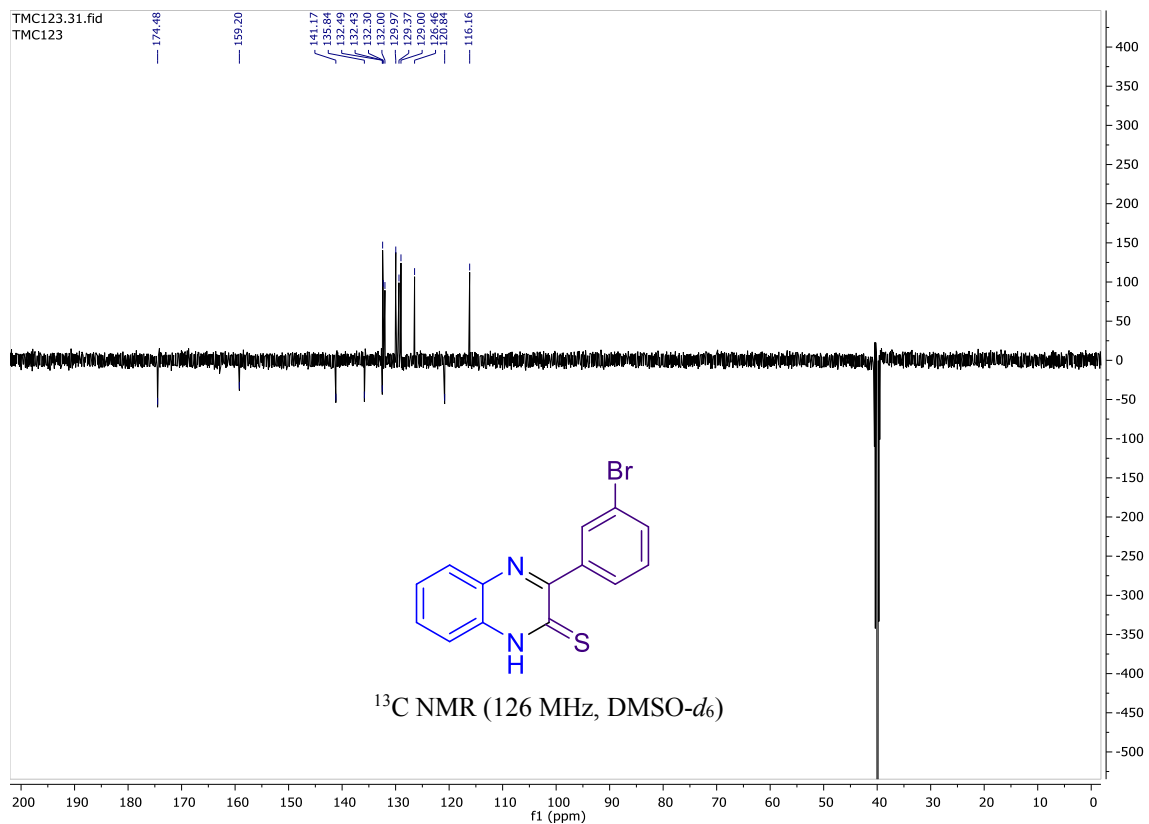
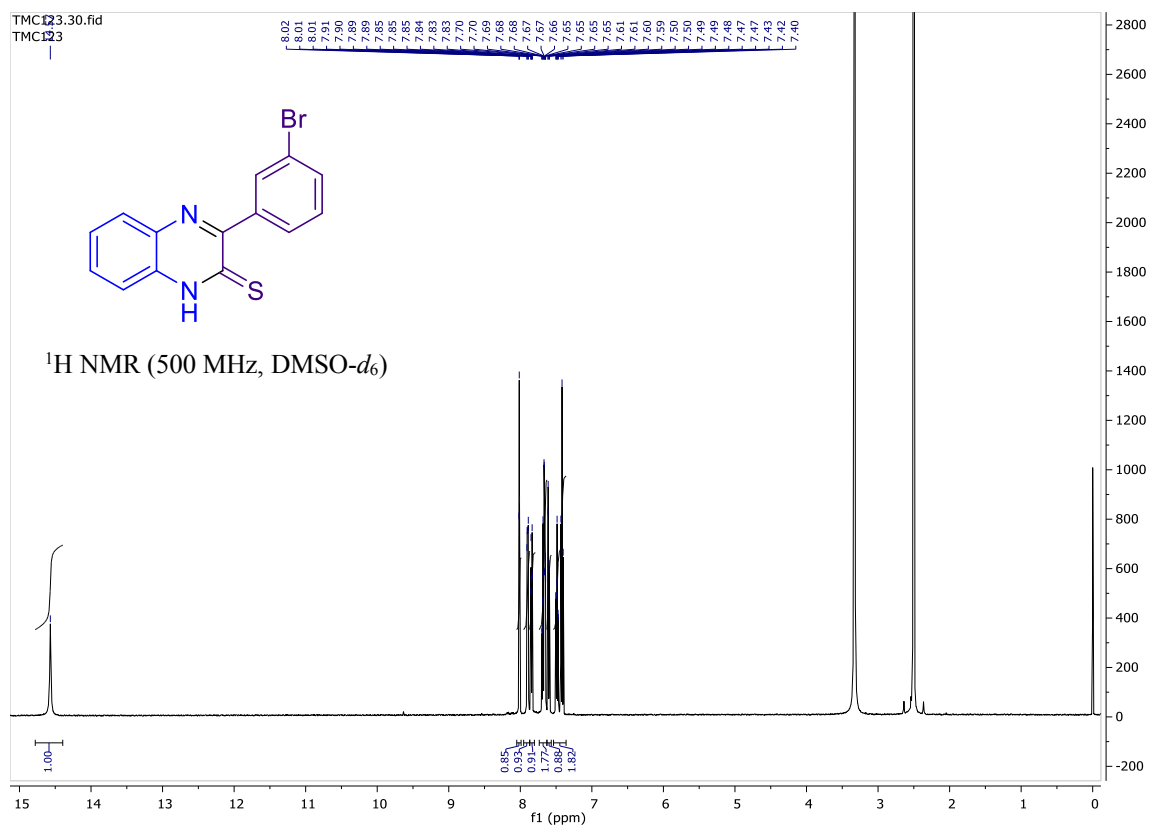
3-(3-Chlorophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3be)



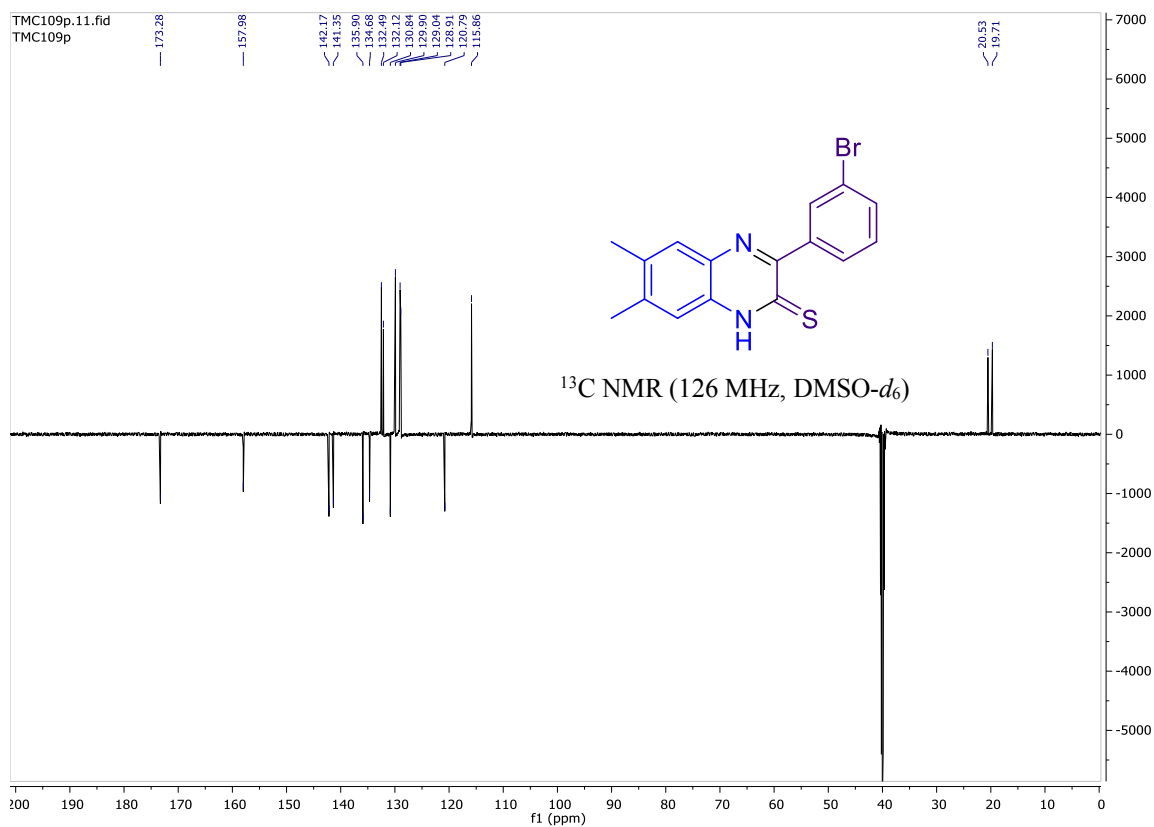
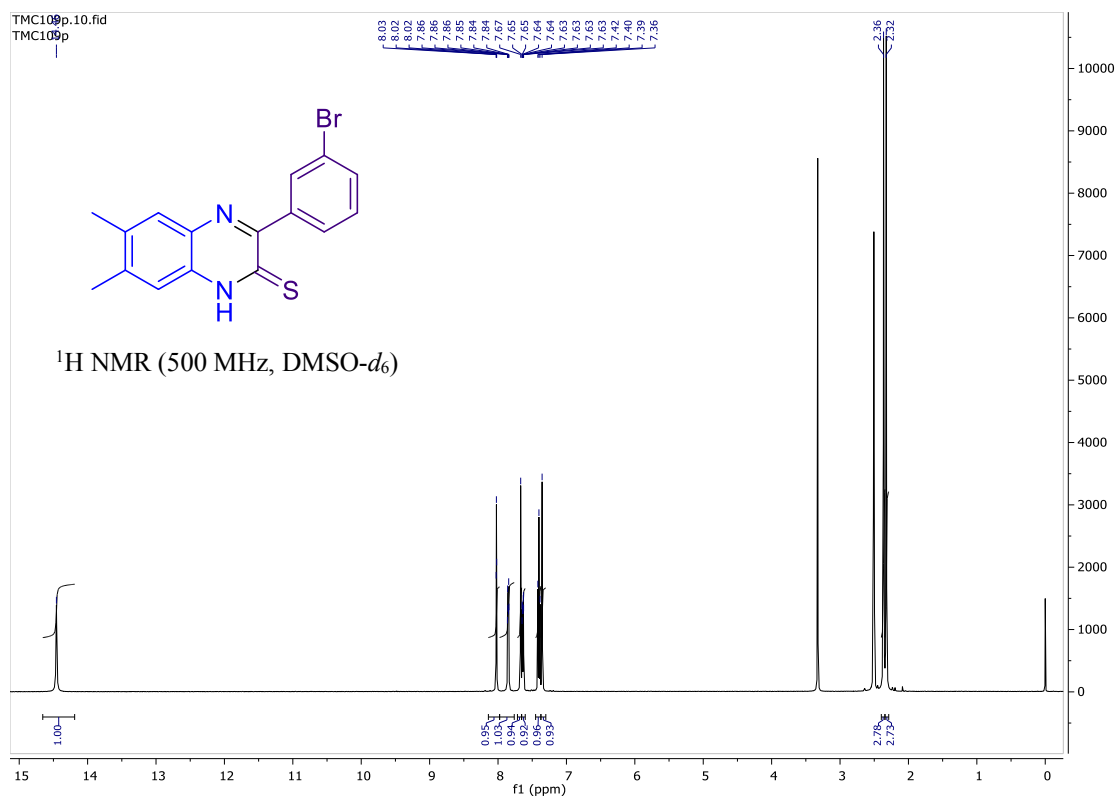
3-(2-Chlorophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bf)



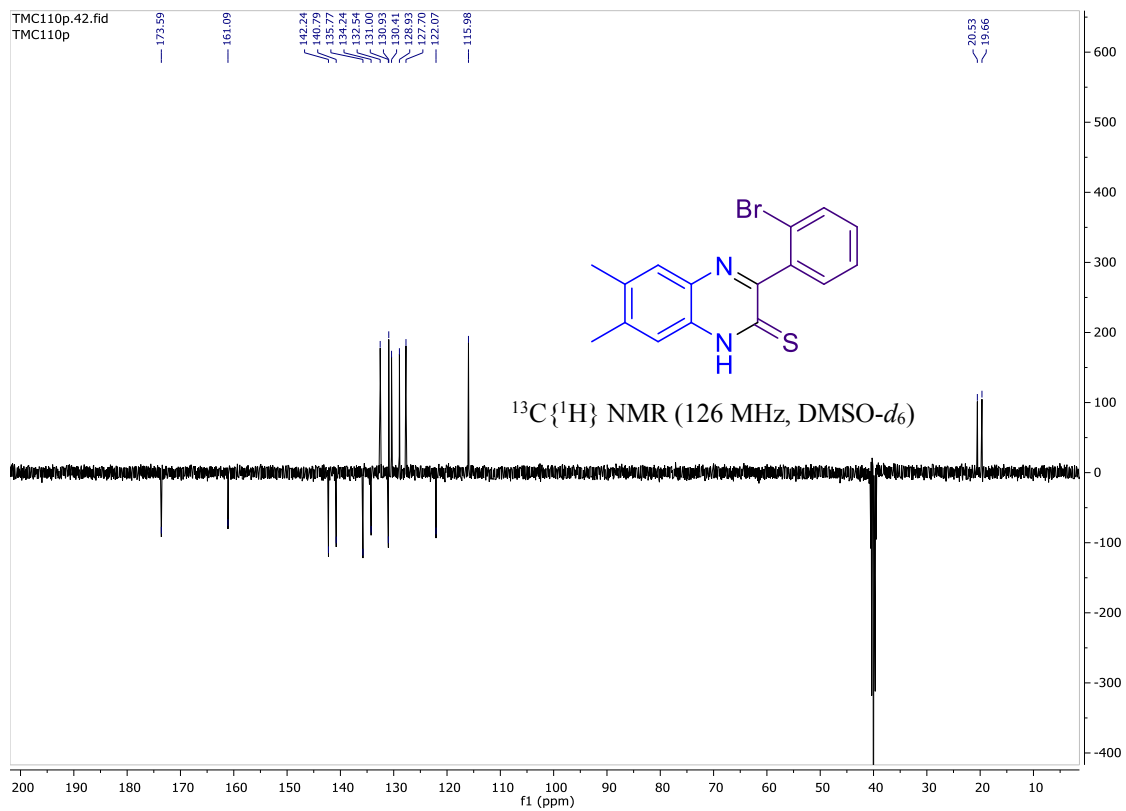
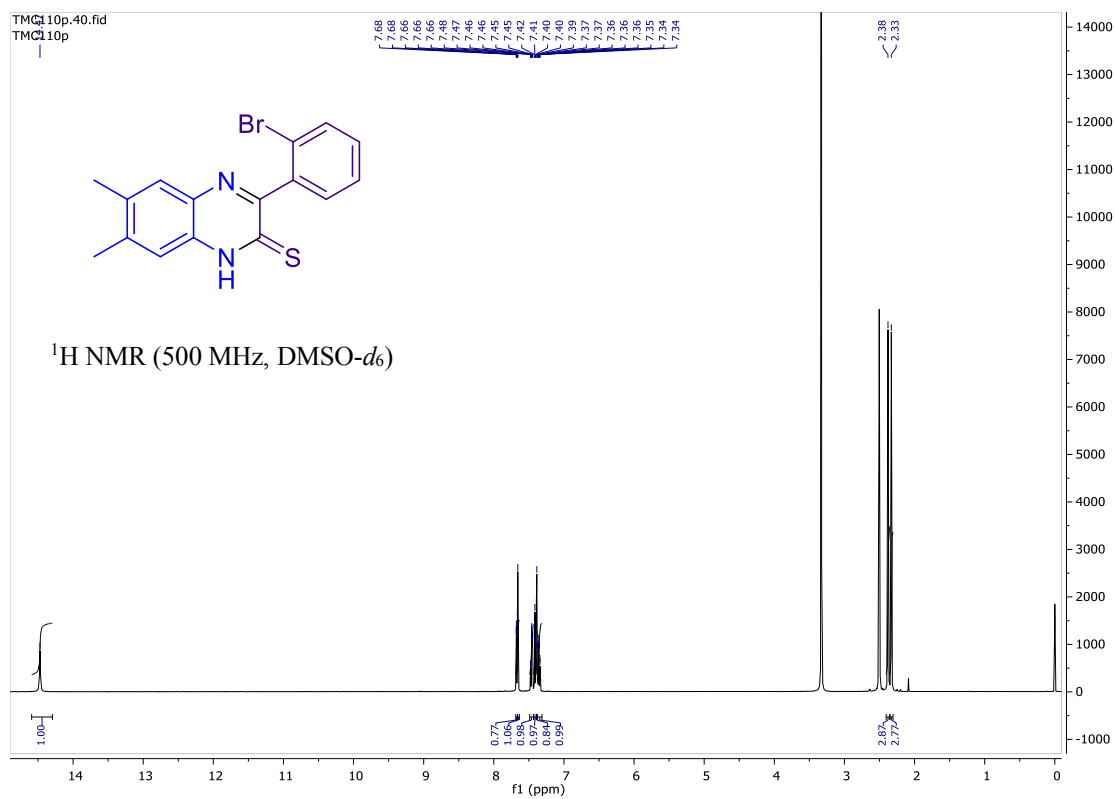
3-(3-Bromophenyl)quinoxaline-2(1H)-thione (3ag)



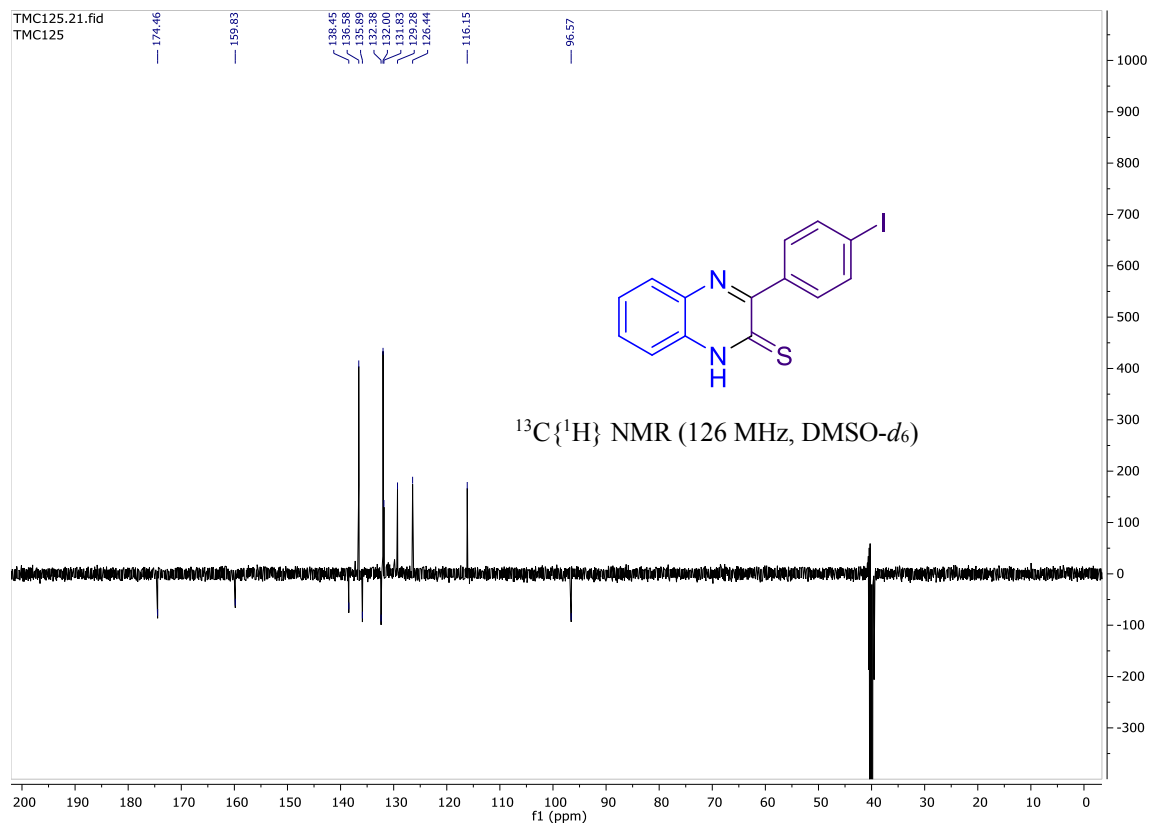
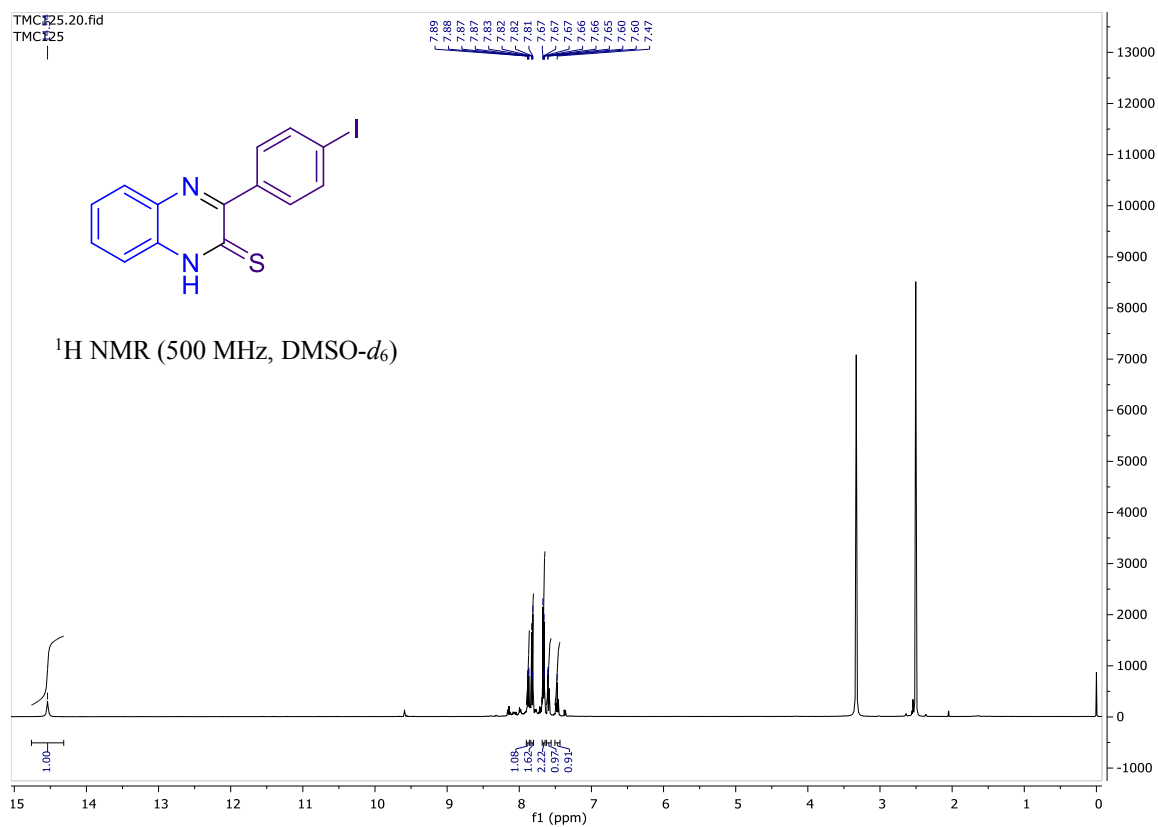
3-(3-Bromophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bg)



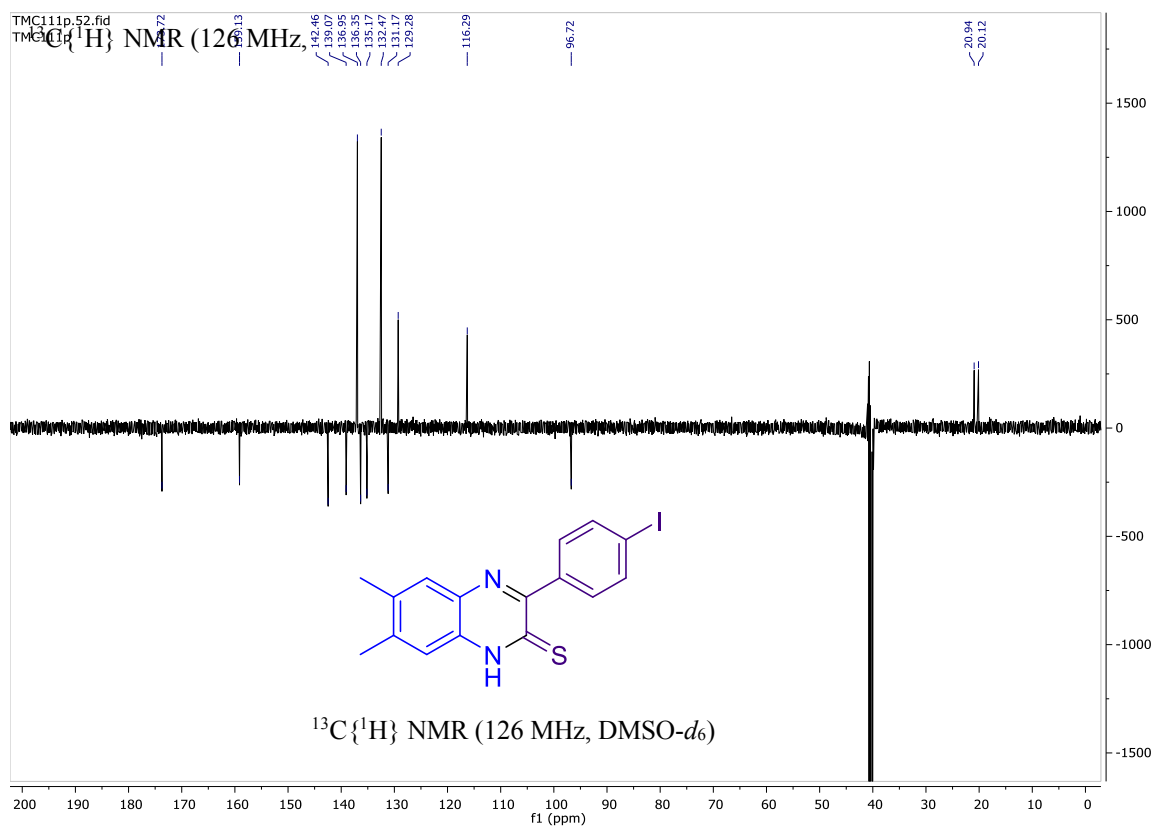
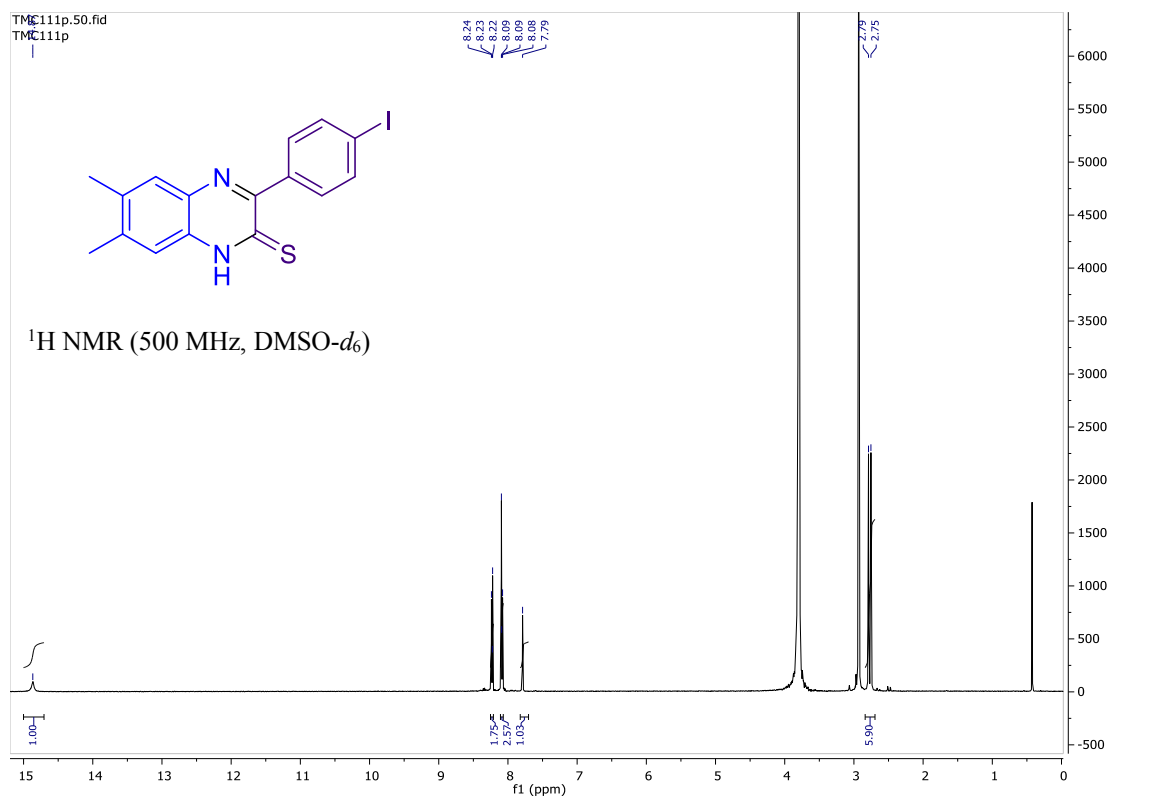
3-(2-Bromophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bh)



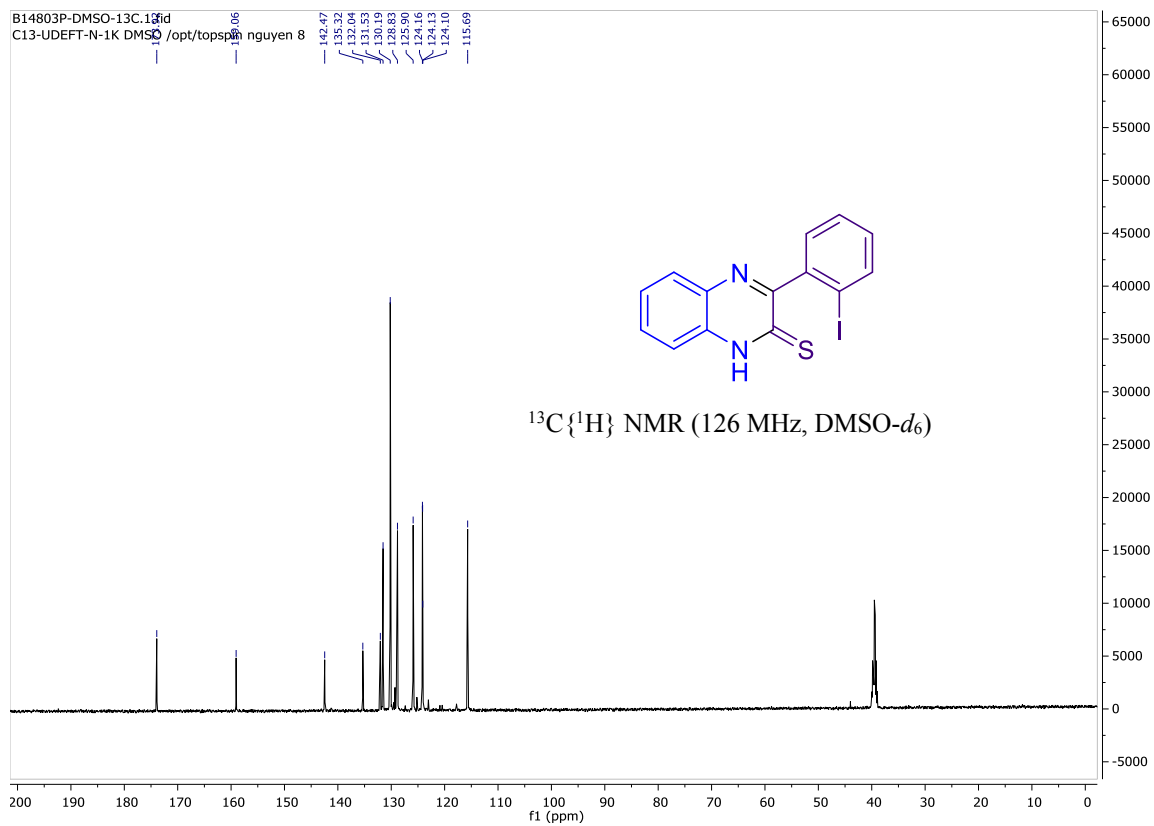
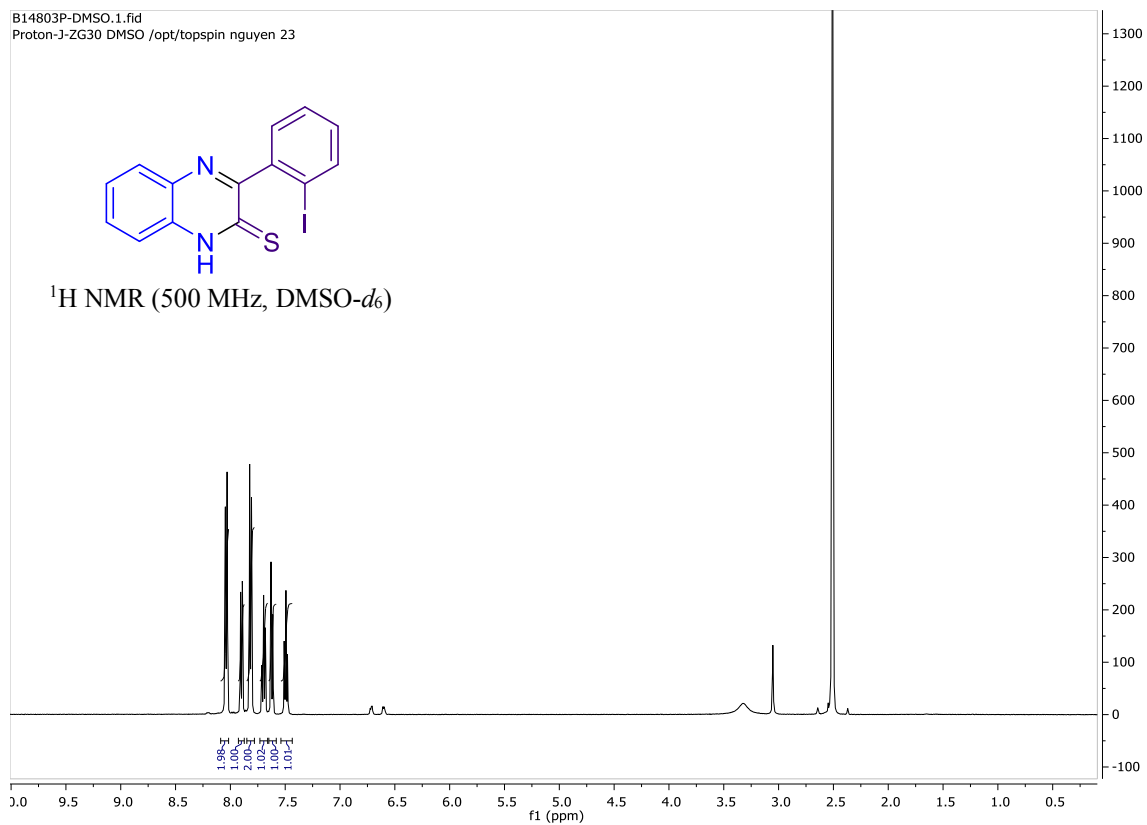
3-(4-Iodophenyl)quinoxaline-2(1H)-thione (3ai)



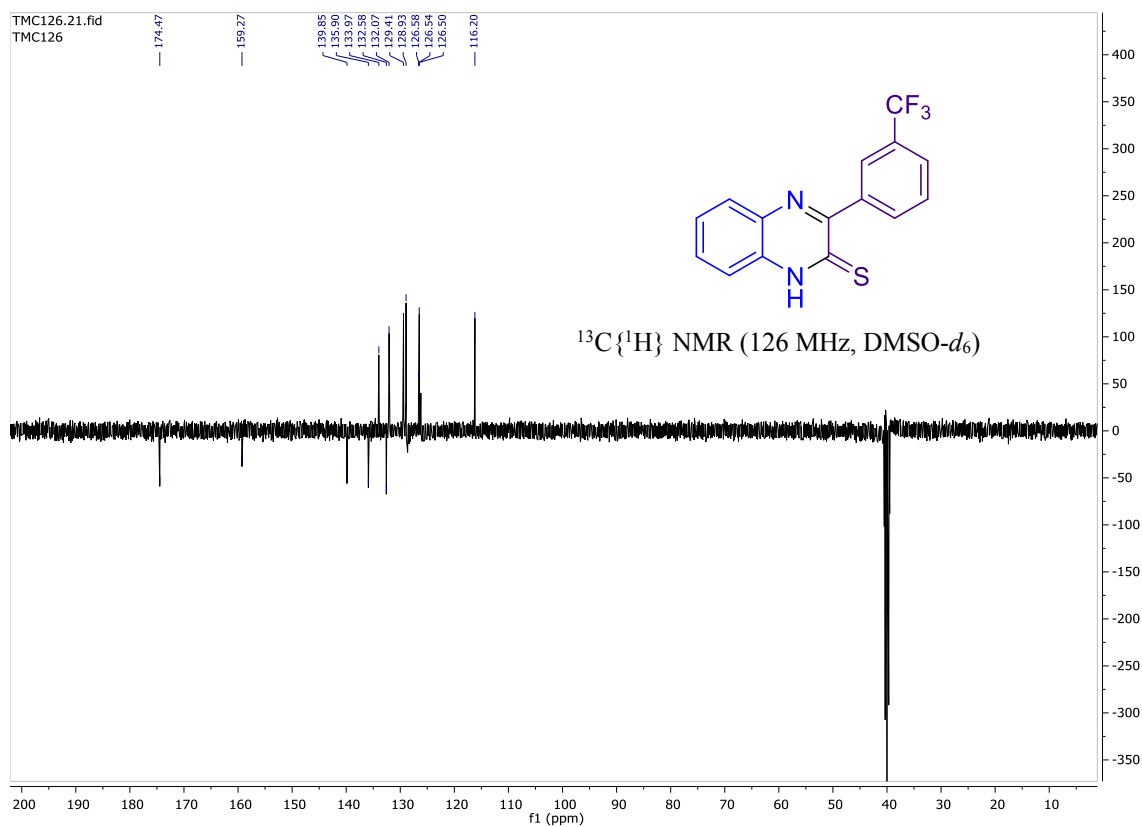
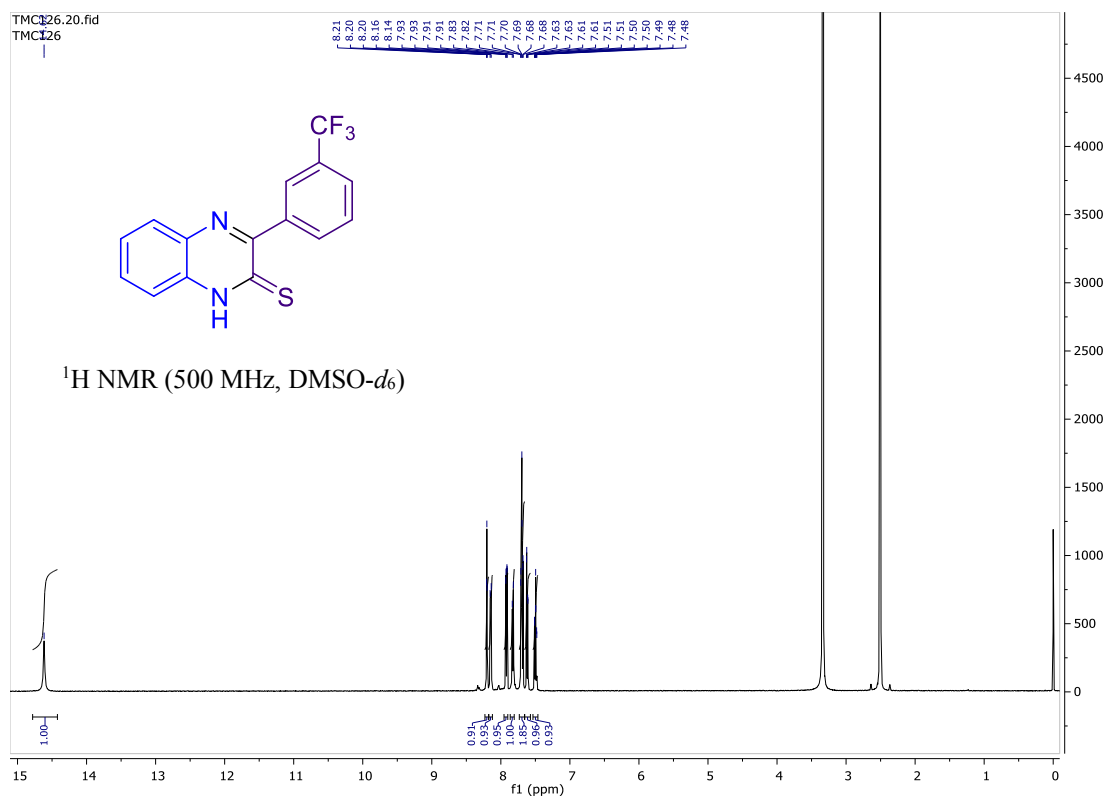
3-(4-Iodophenyl)-6,7-dimethylquinoxaline-2(1H)-thione (3bi)



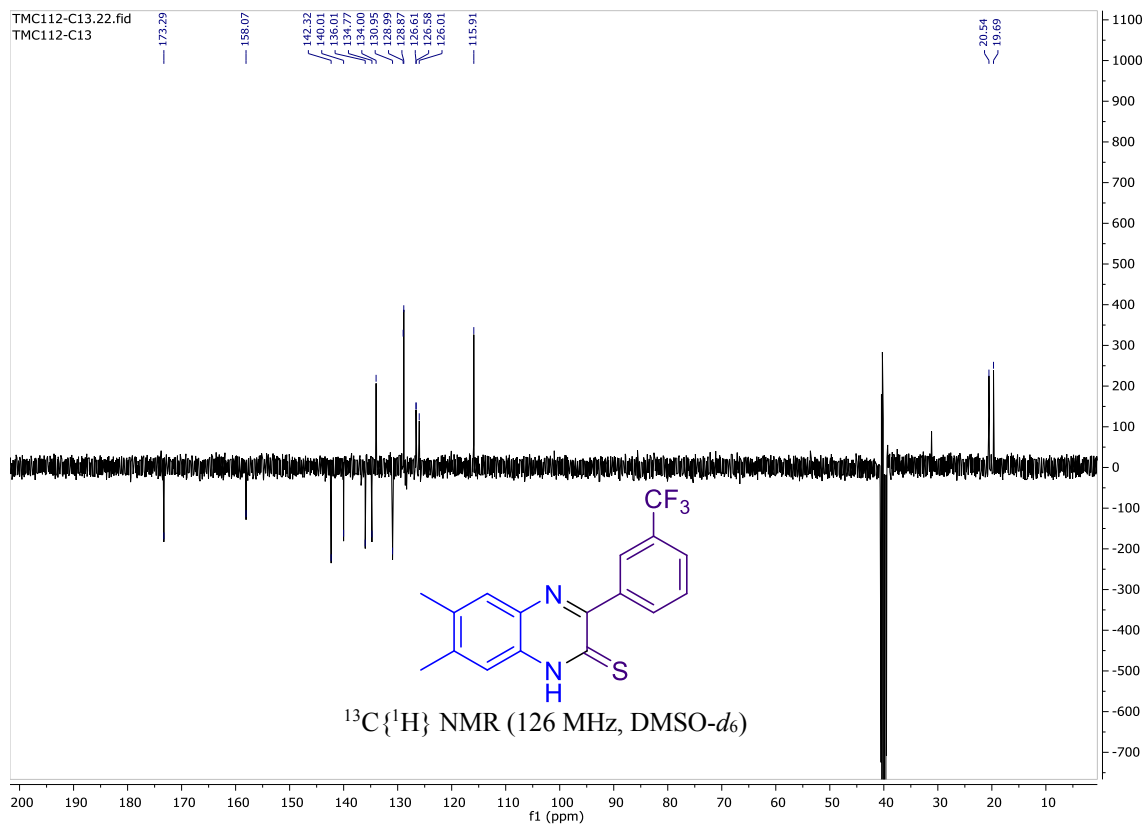
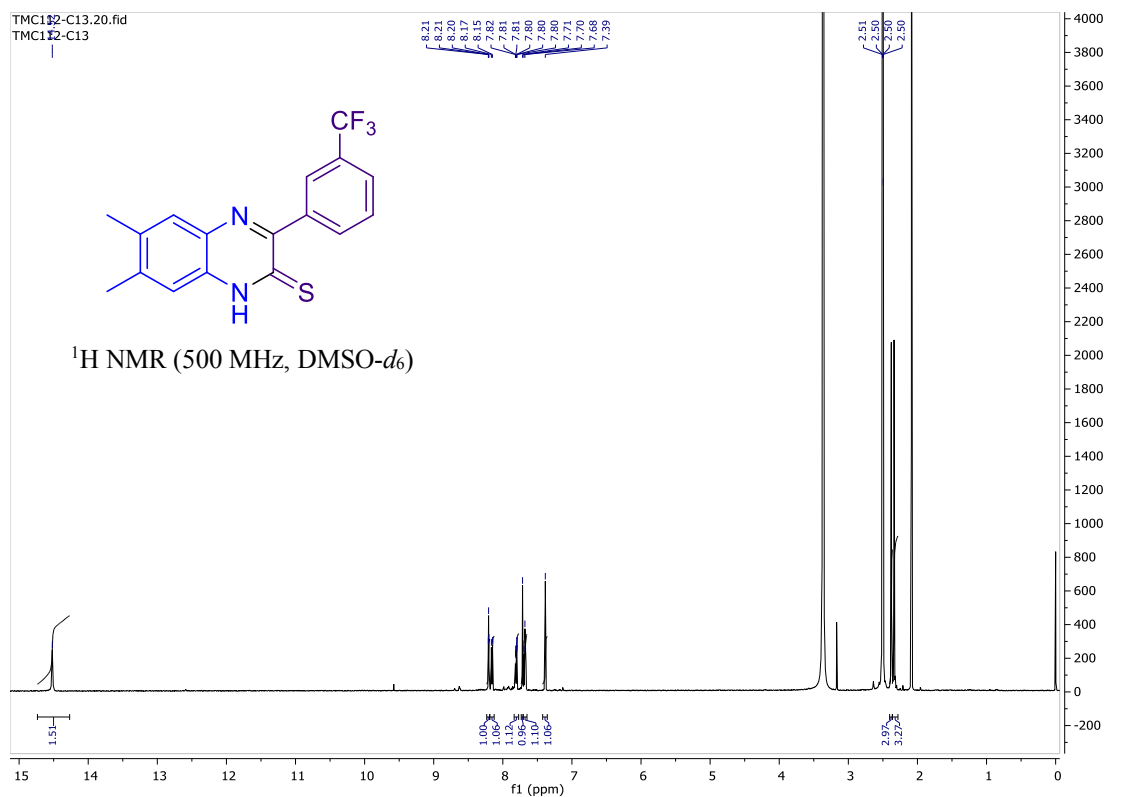
3-(2-Iodophenyl)quinoxaline-2(1H)-thione (3aj)



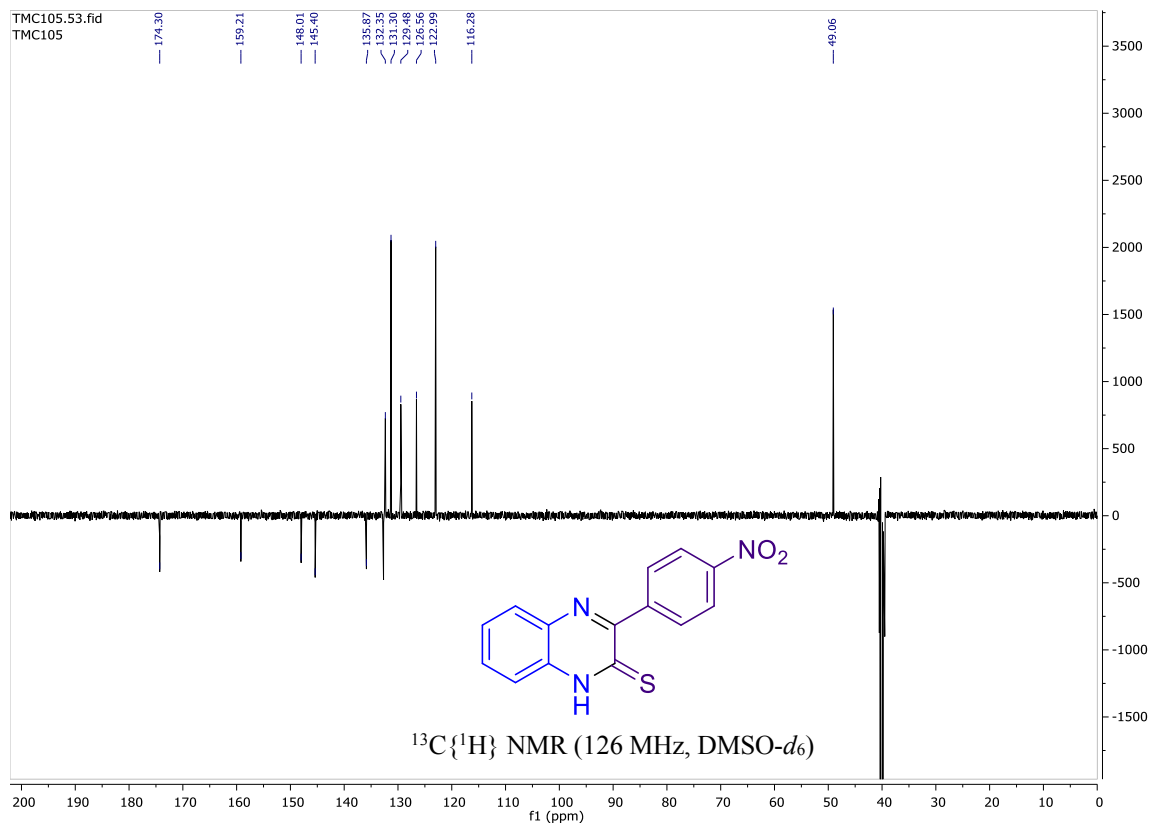
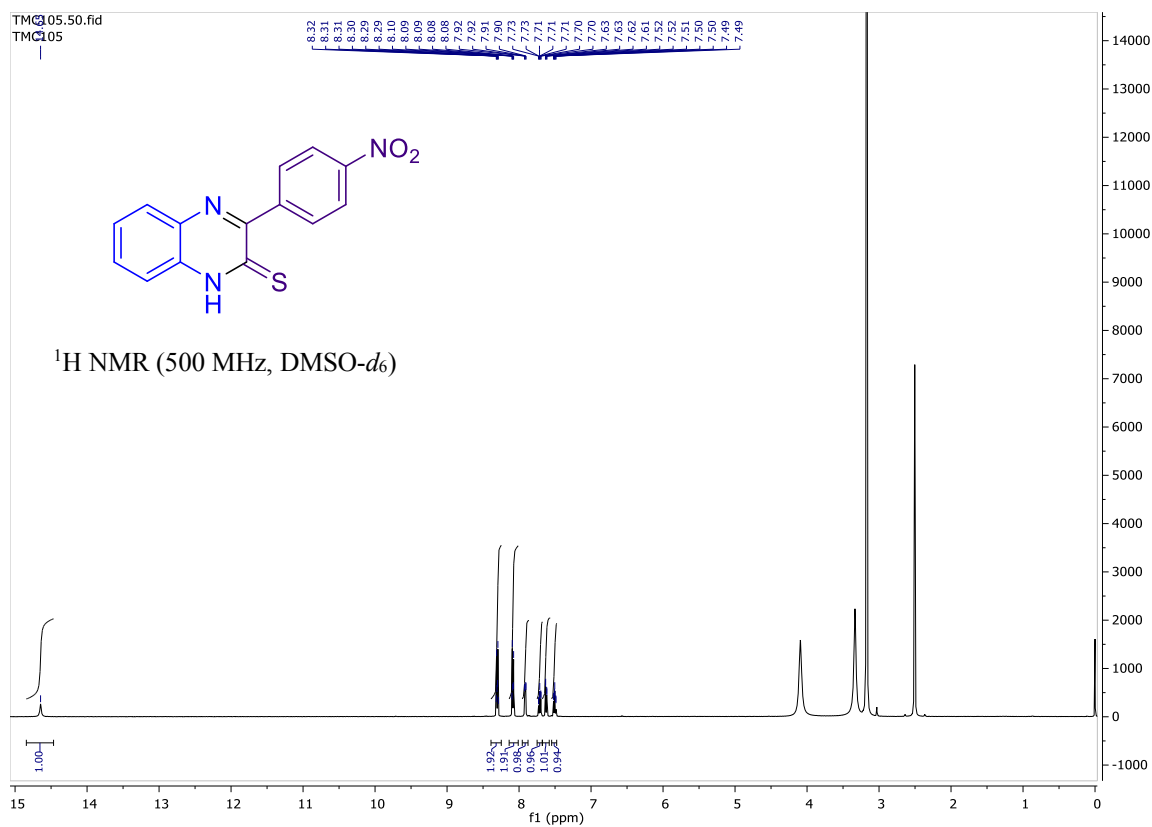
3-(3-(Trifluoromethyl)phenyl)quinoxaline-2(1H)-thione (3ak)



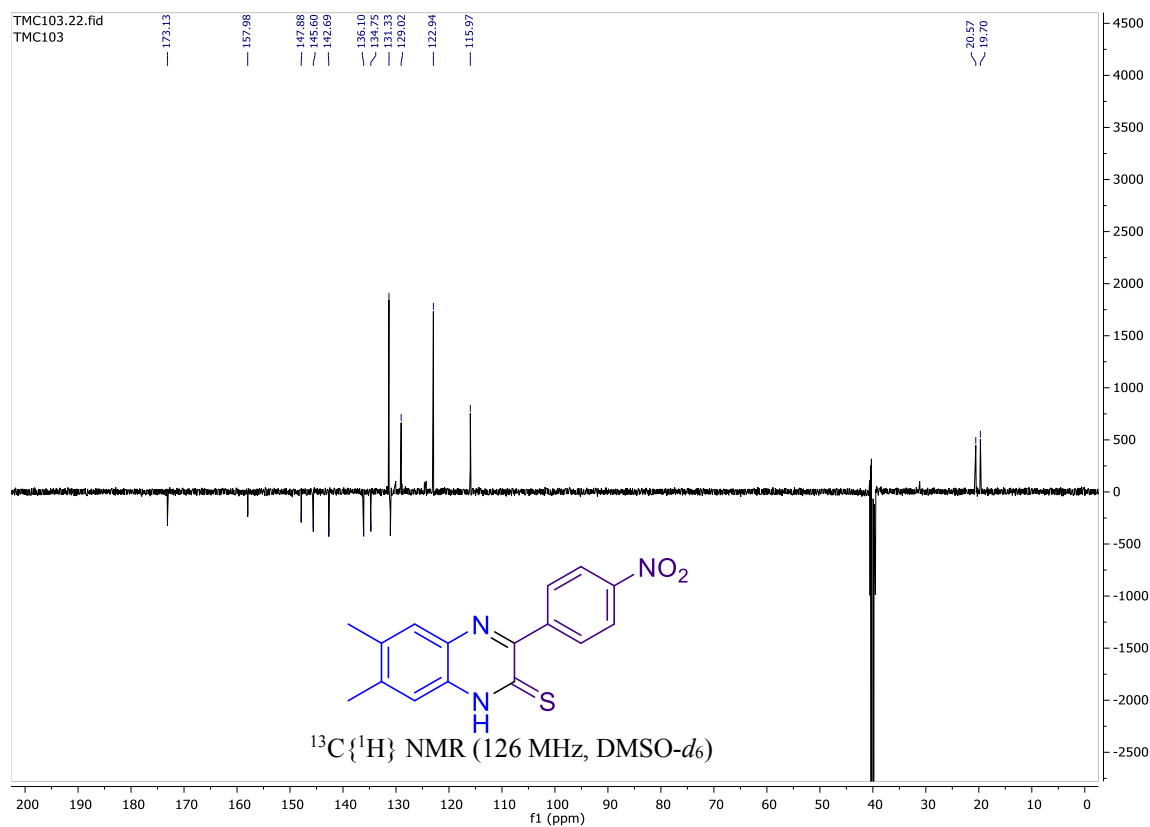
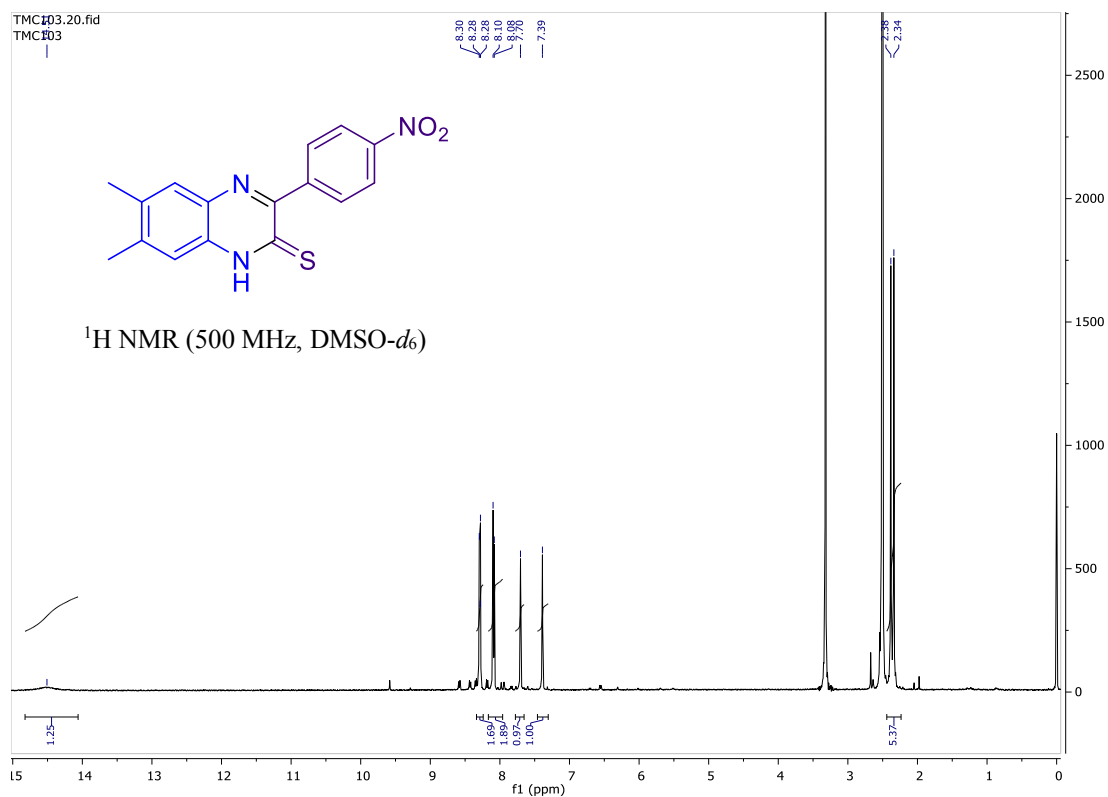
6,7-Dimethyl-3-(3-(trifluoromethyl)phenyl)quinoxaline-2(1H)-thione (3bk)



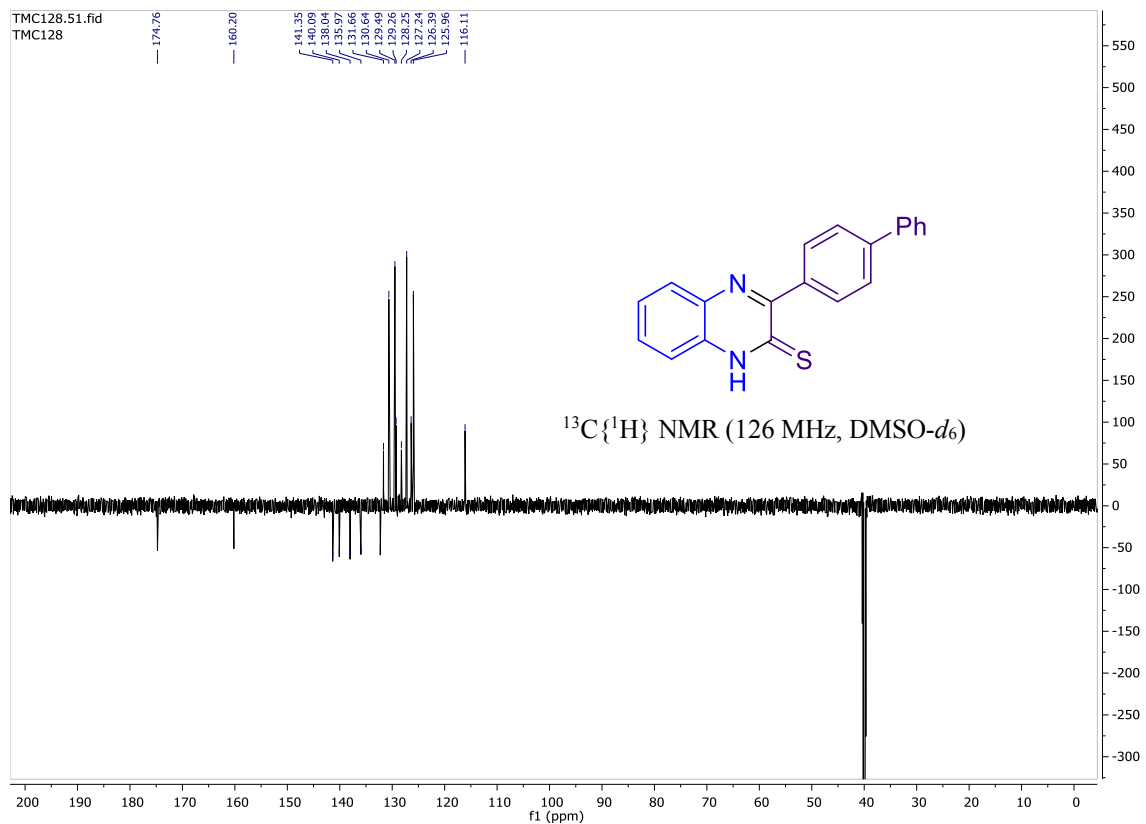
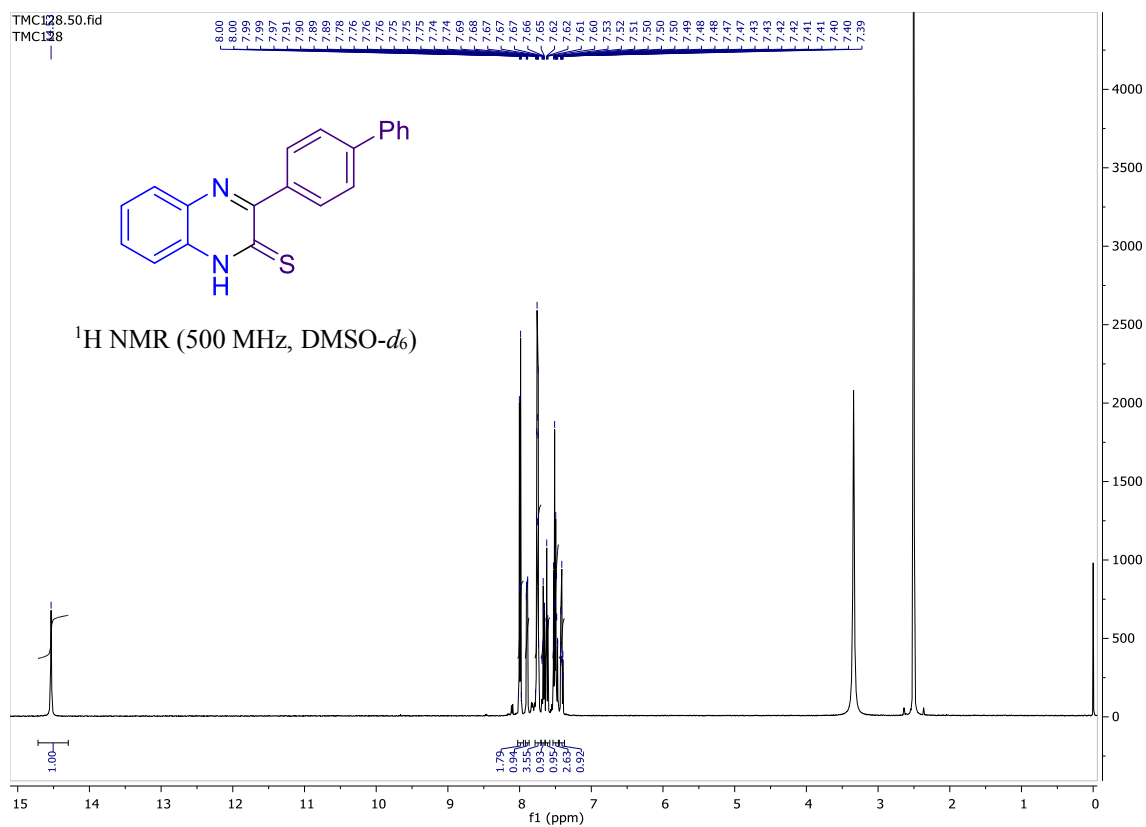
3-(4-Nitrophenyl)quinoxaline-2(1H)-thione (3a)



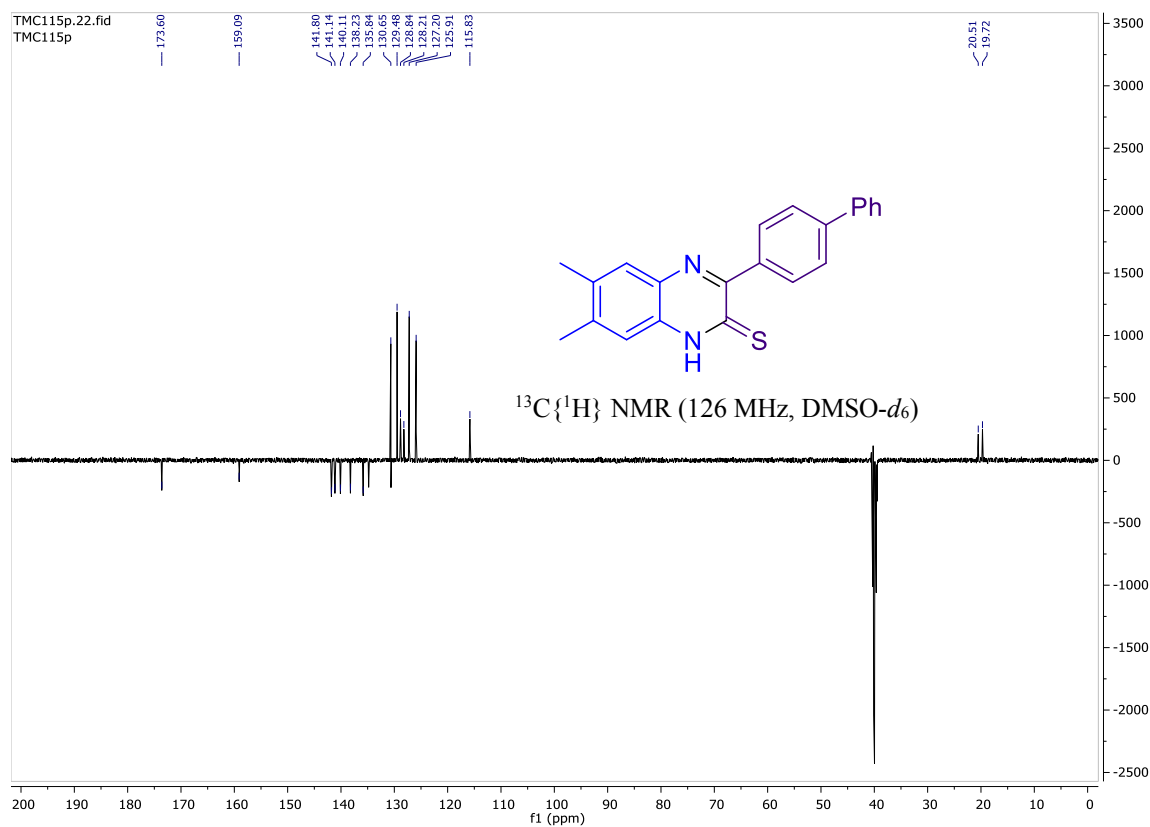
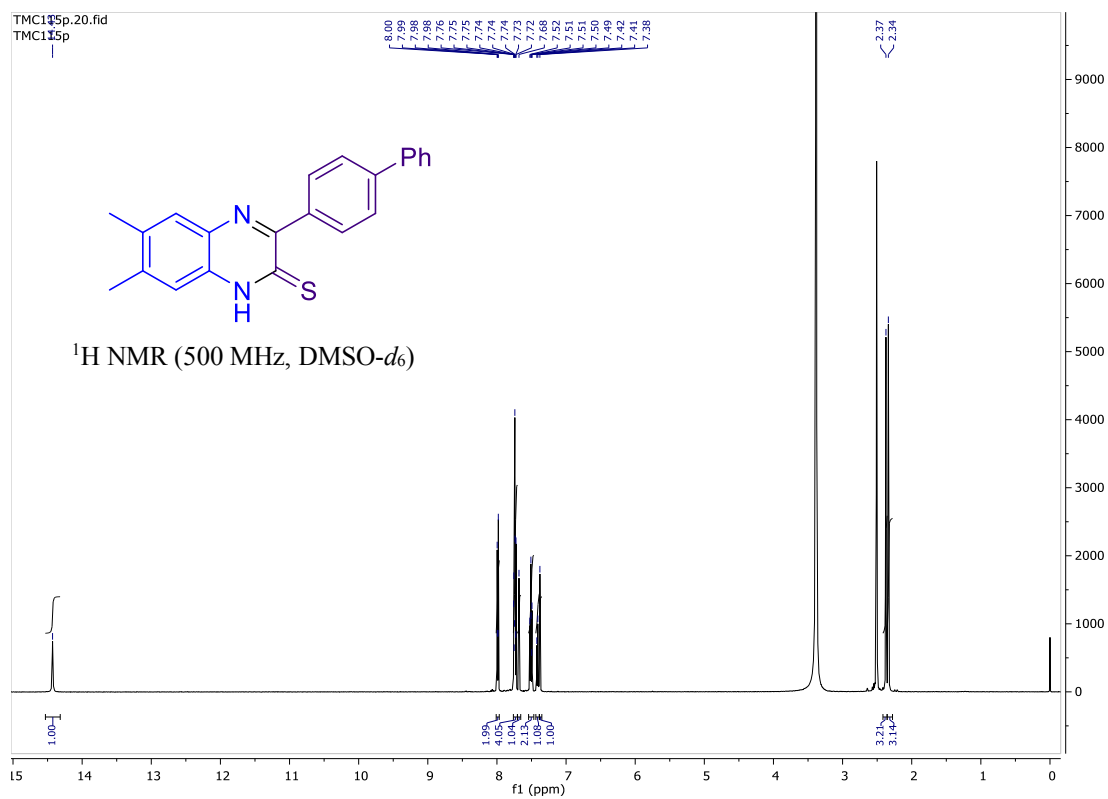
6,7-Dimethyl-3-(4-nitrophenyl)quinoxaline-2(1H)-thione (3bl)



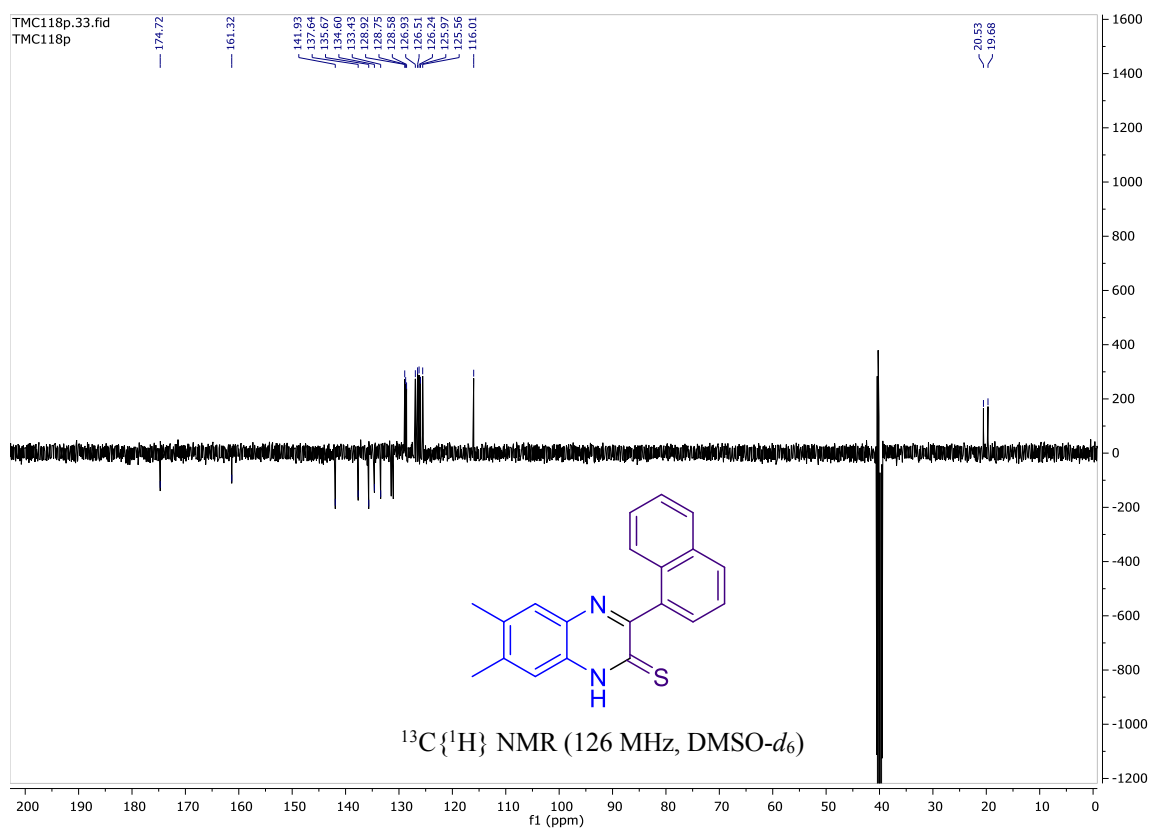
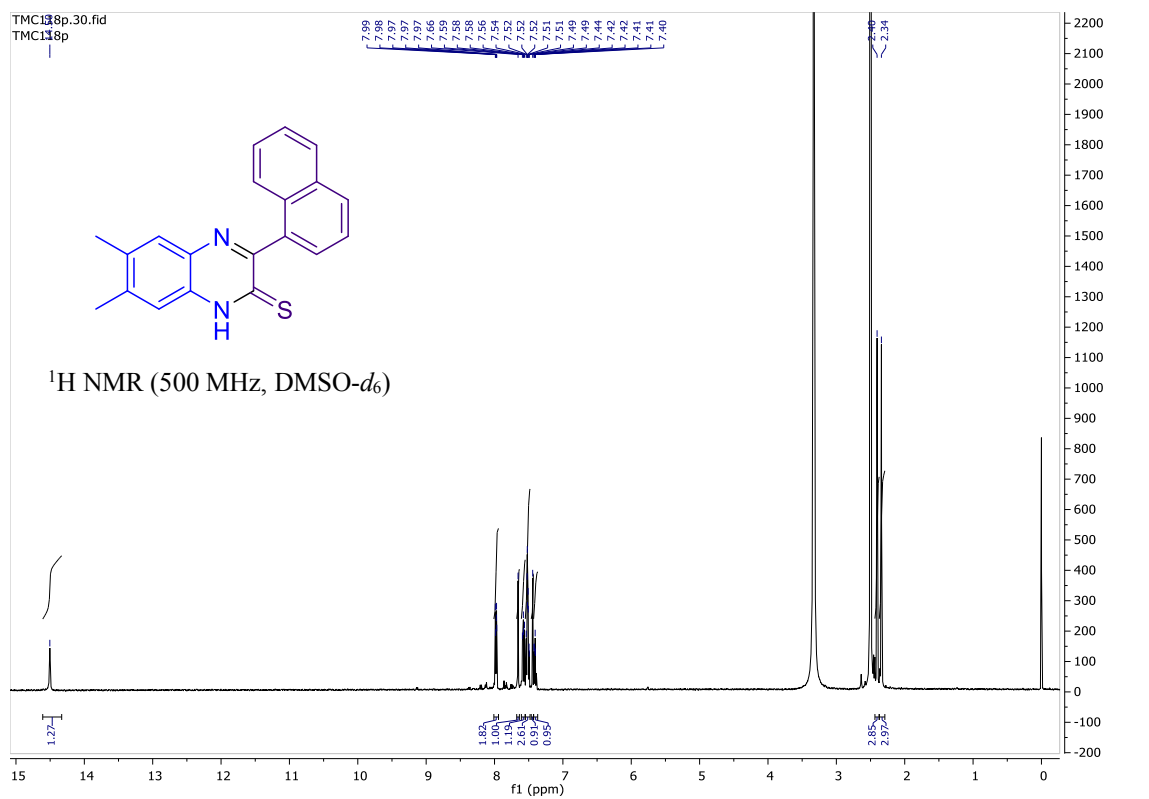
3-([1,1'-Biphenyl]-4-yl)quinoxaline-2(1H)-thione (3am)



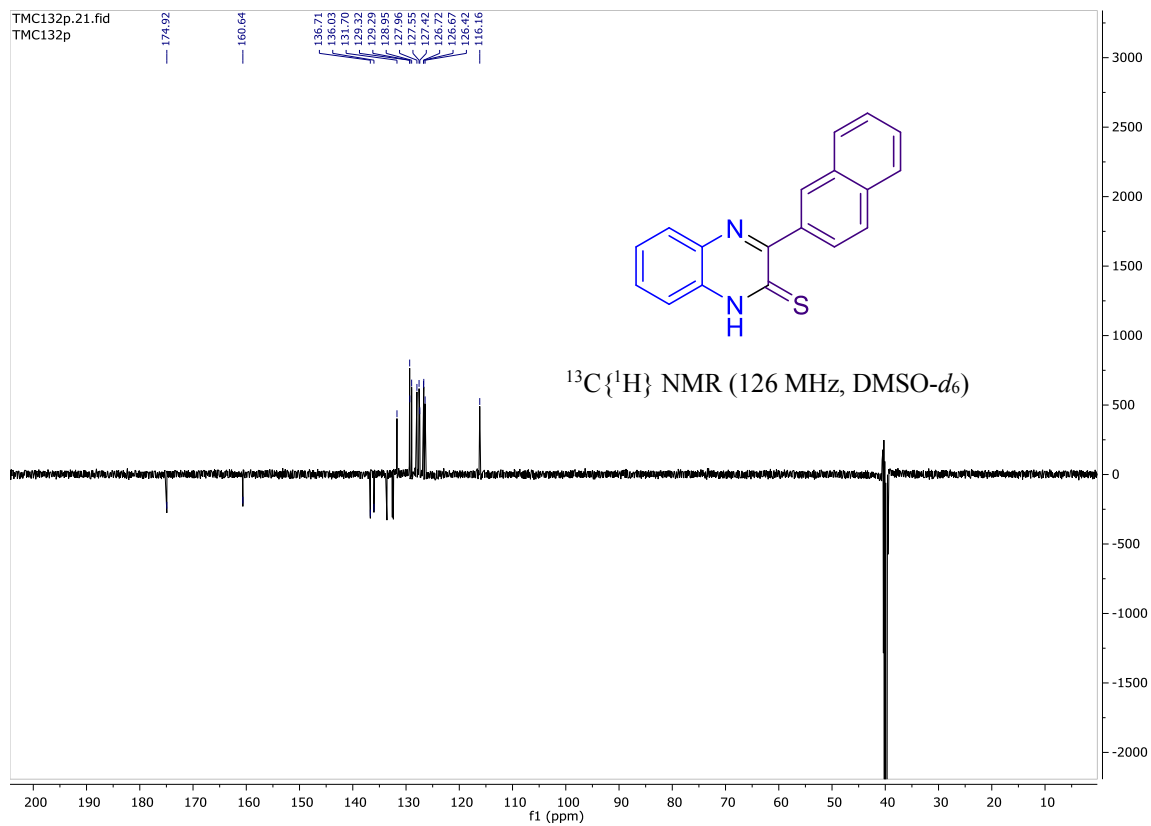
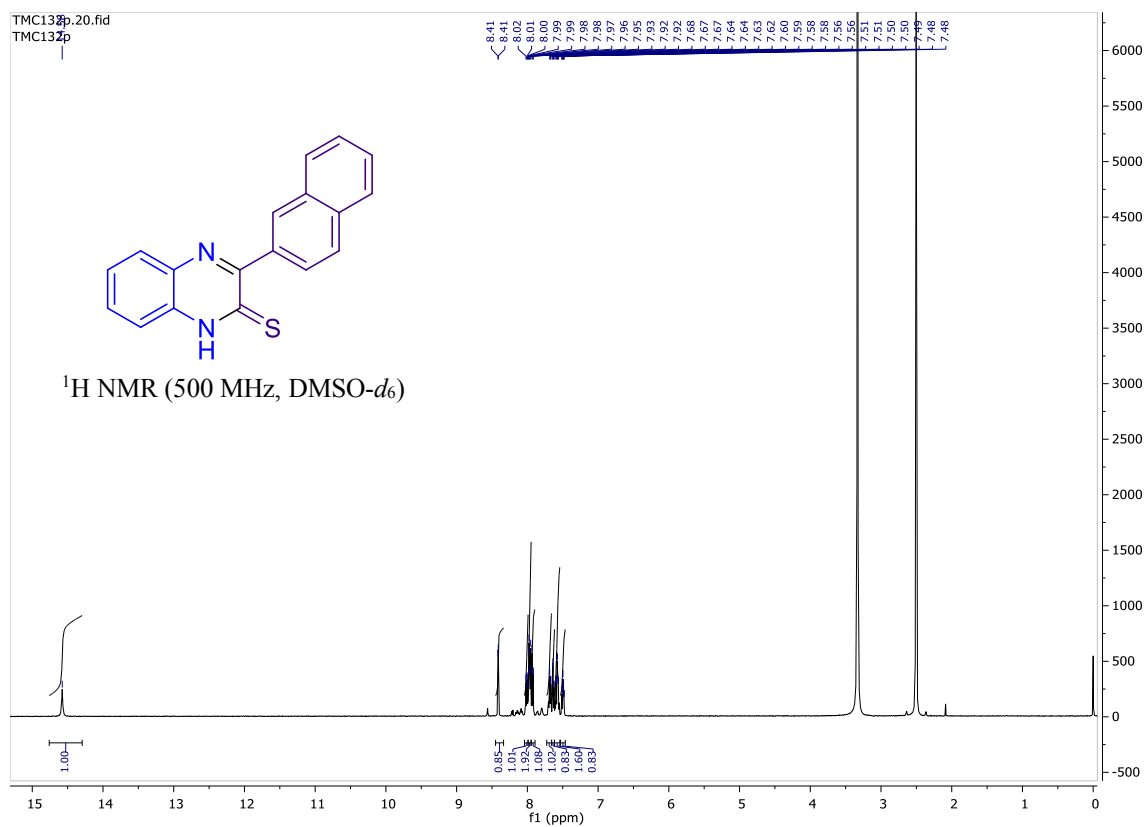
3-([1,1'-Biphenyl]-4-yl)-6,7-dimethylquinoxaline-2(1H)-thione (3bm)



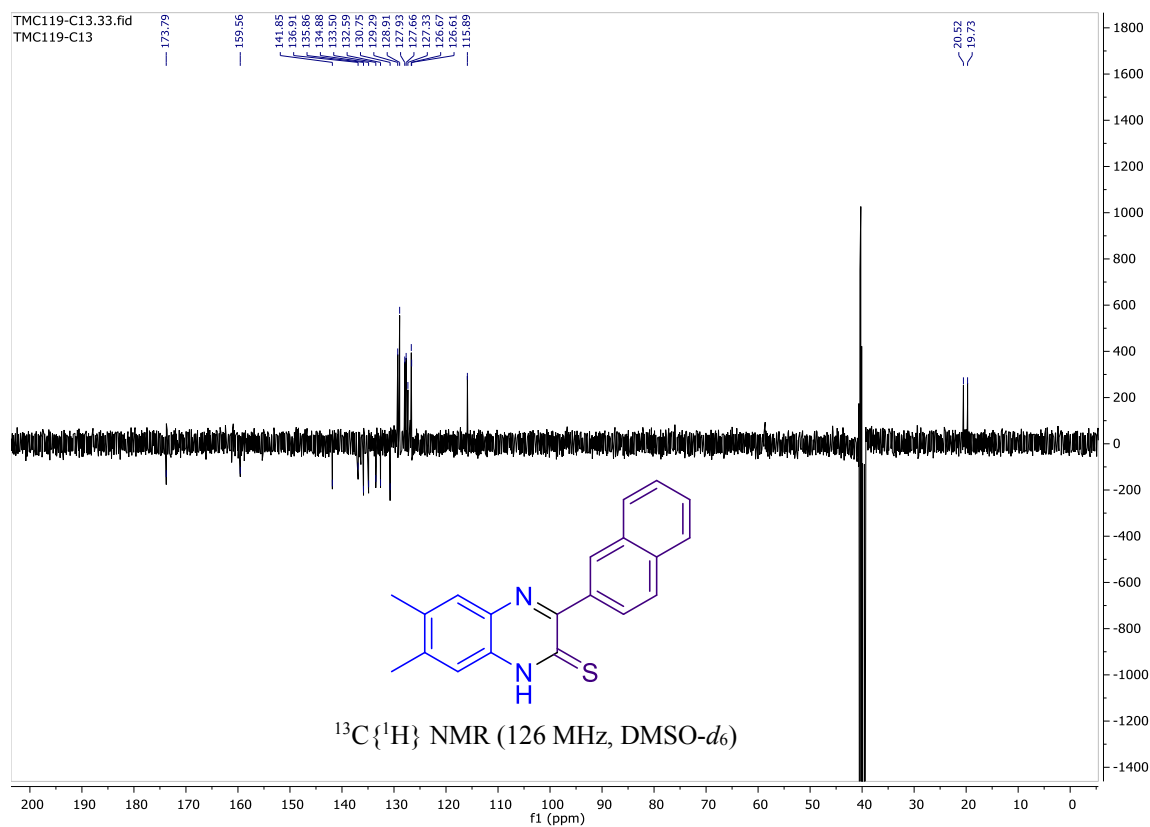
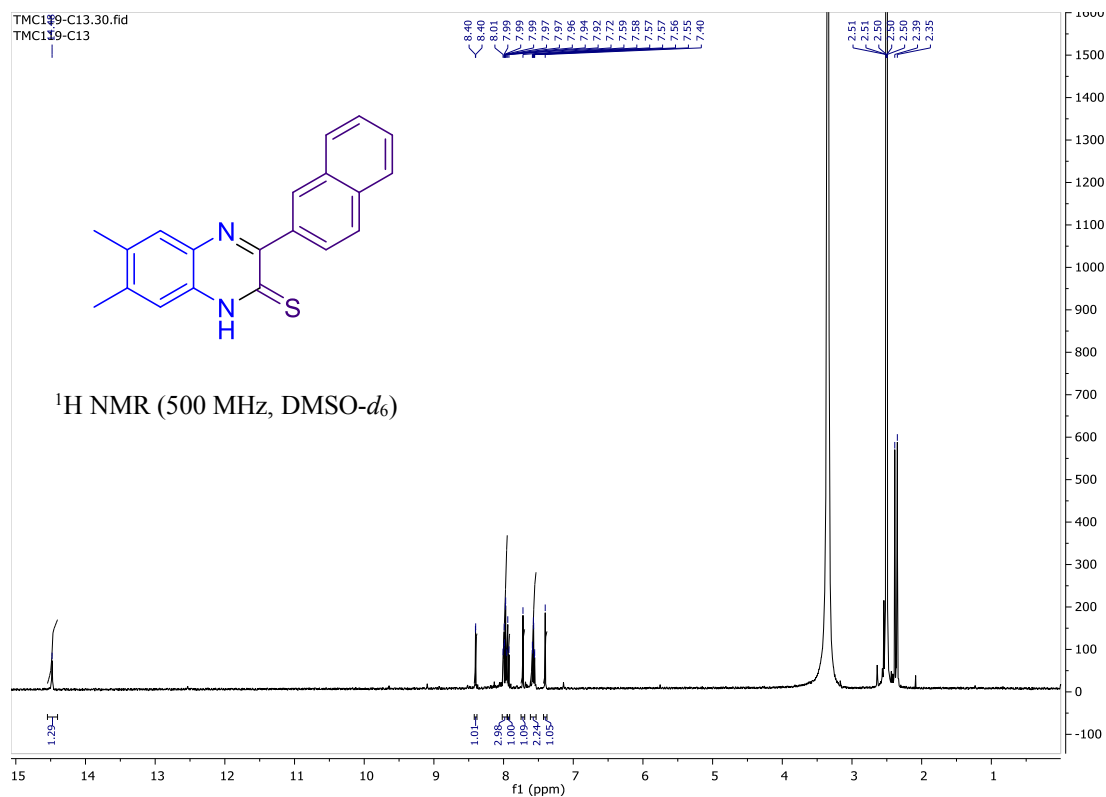
6,7-Dimethyl-3-(naphthalen-1-yl)quinoxaline-2(1H)-thione (3bn)



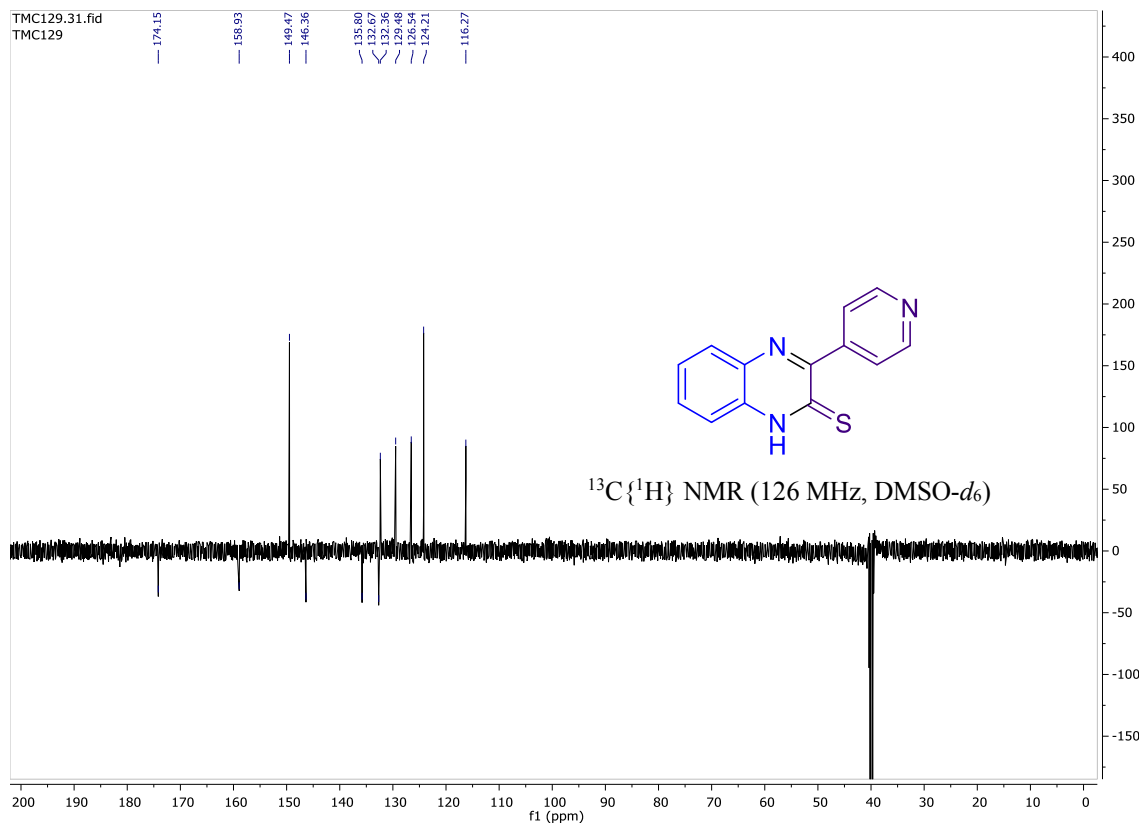
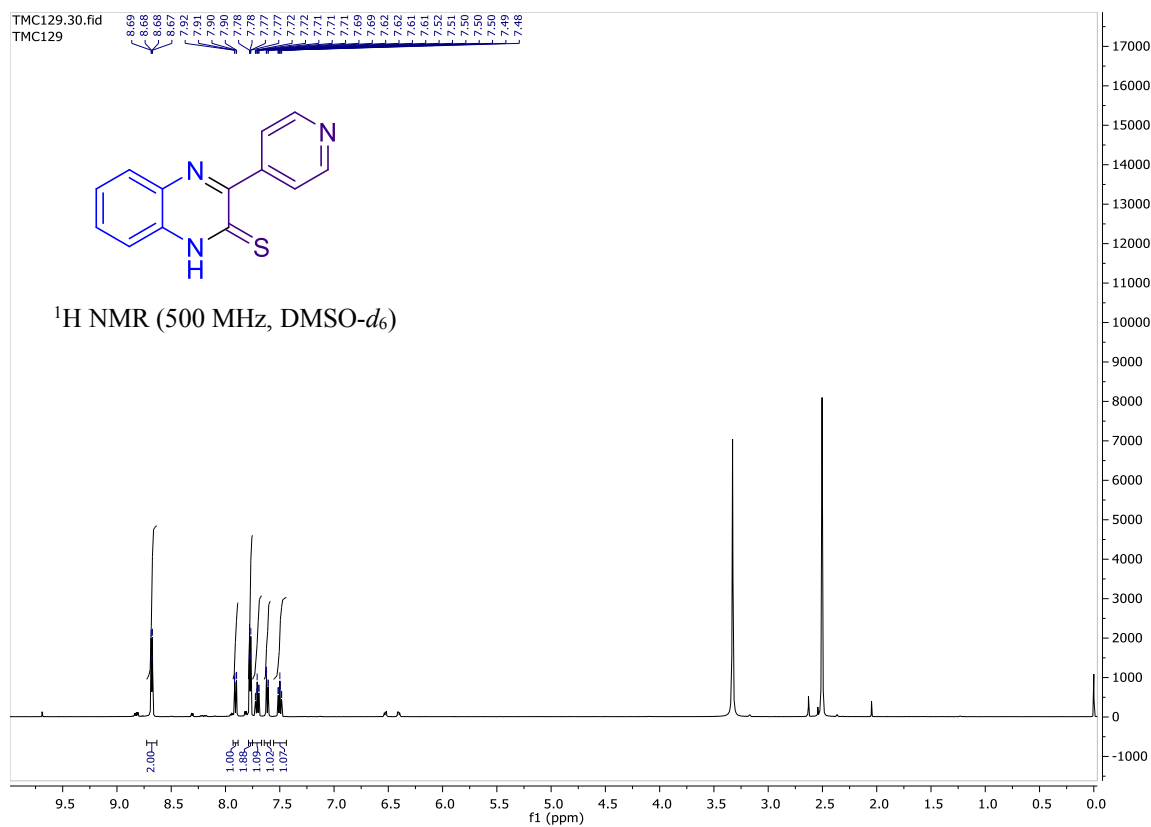
3-(Naphthalen-2-yl)quinoxaline-2(1H)-thione (3ao)



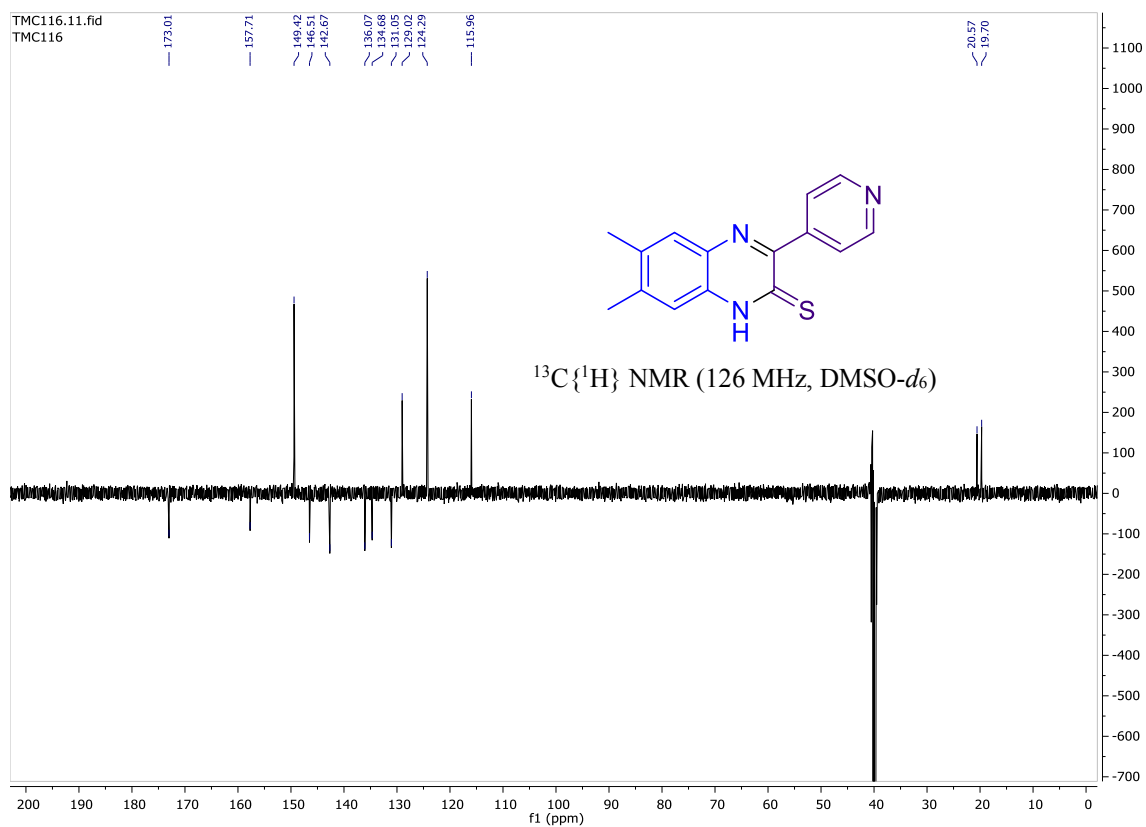
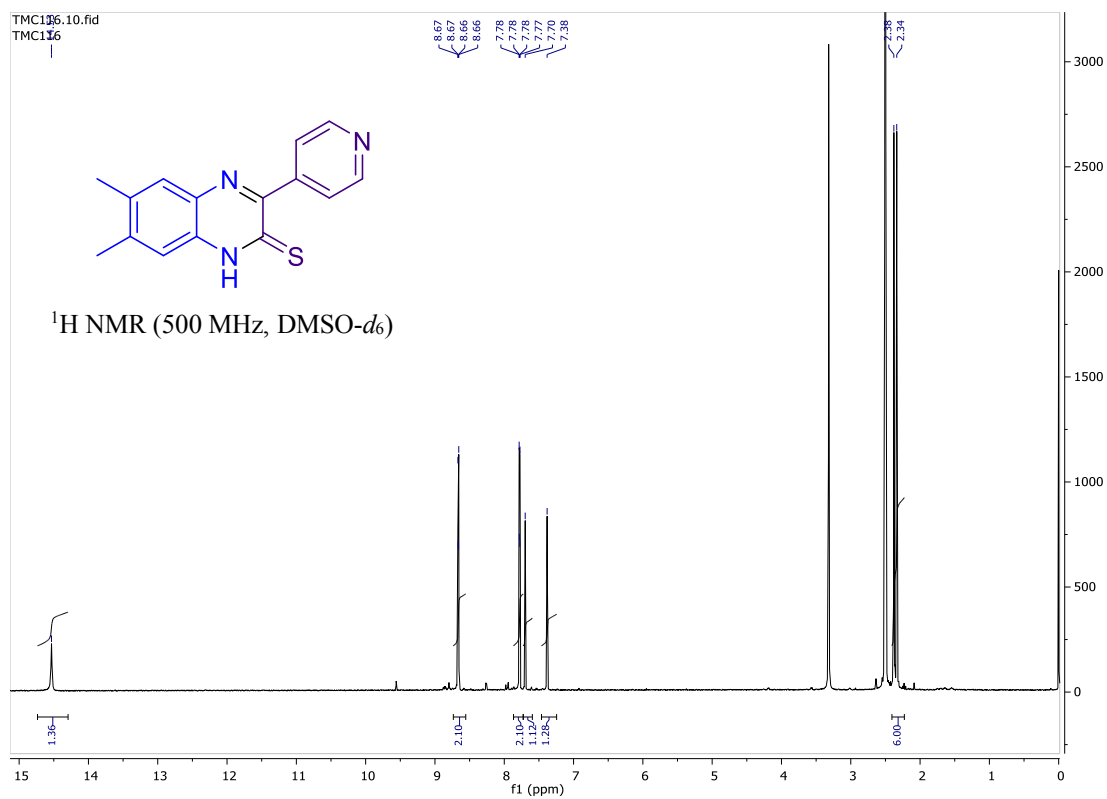
6,7-Dimethyl-3-(naphthalen-2-yl)quinoxaline-2(1H)-thione (3bo)



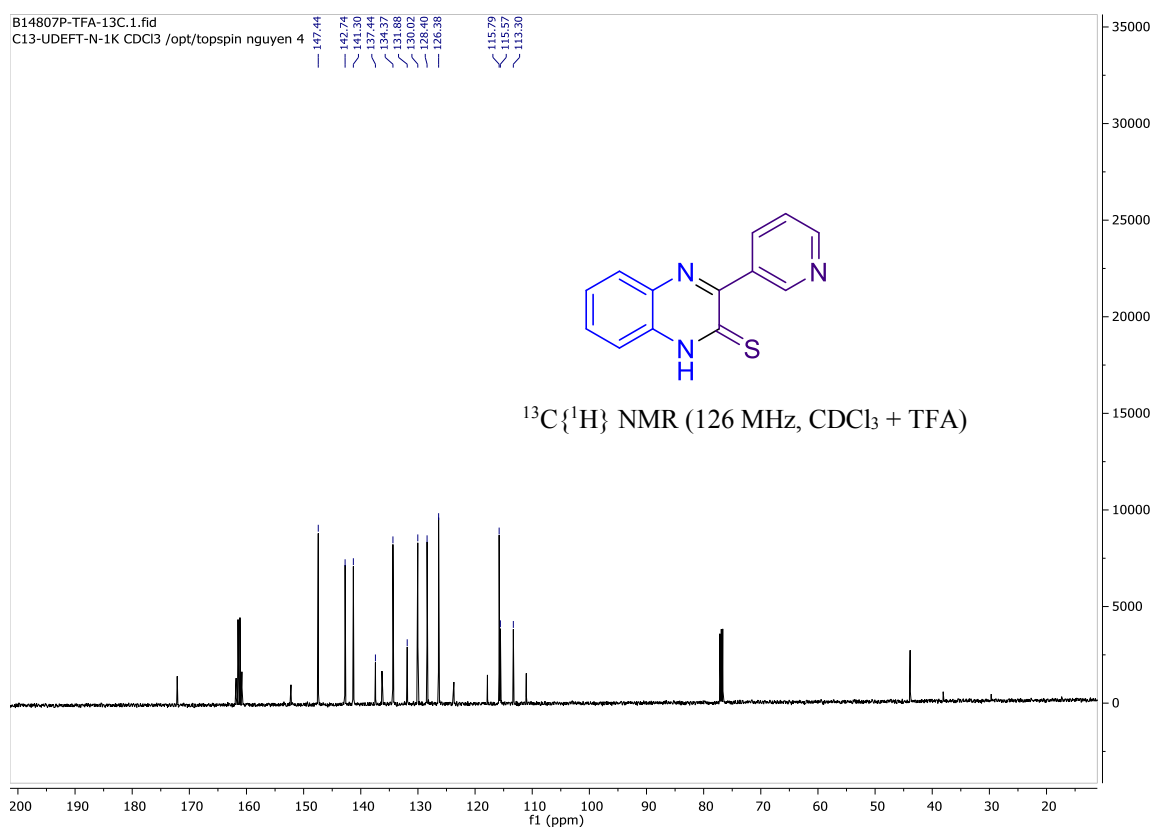
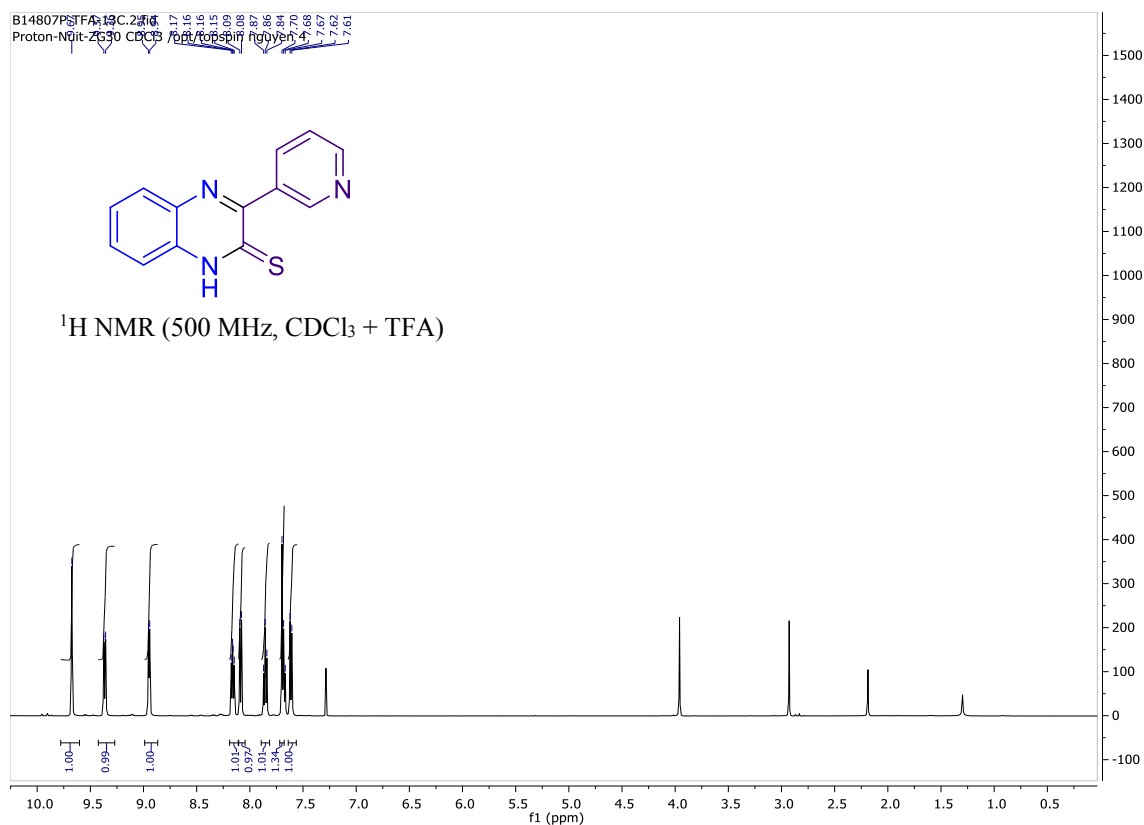
3-(Pyridin-4-yl)quinoxaline-2(1H)-thione (3ap)



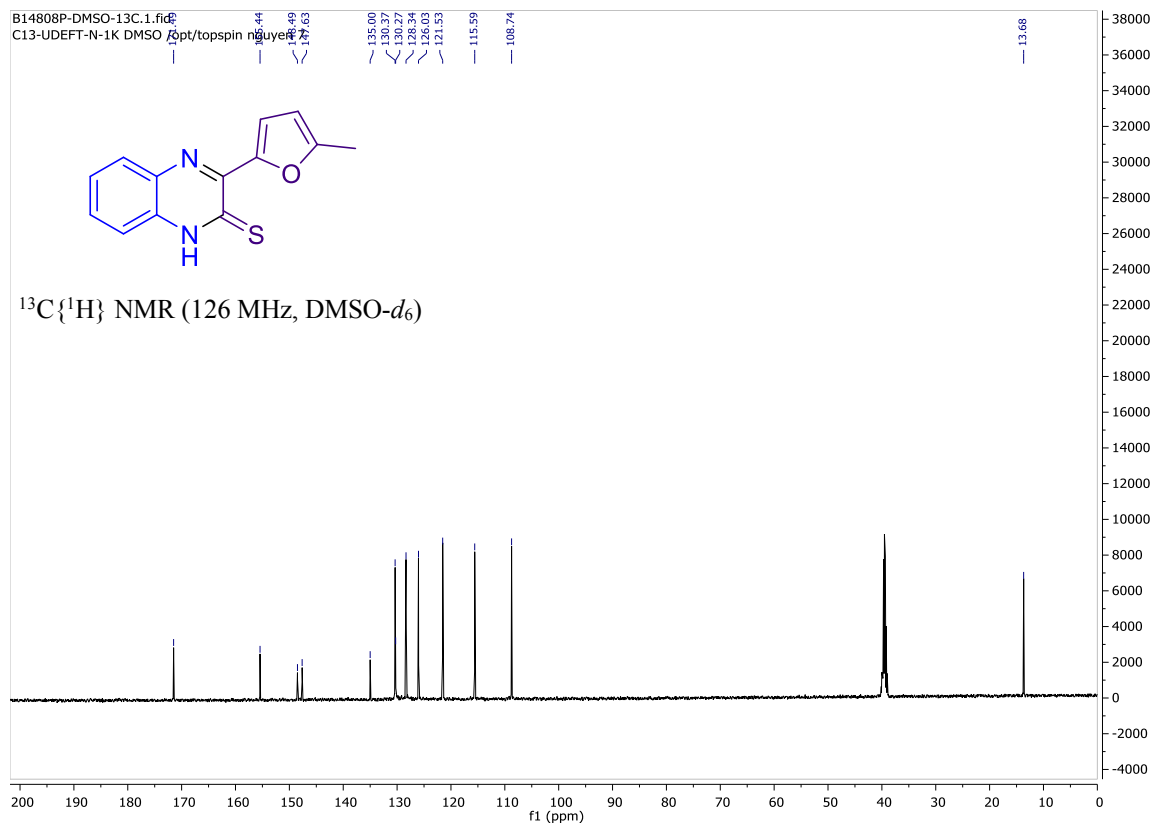
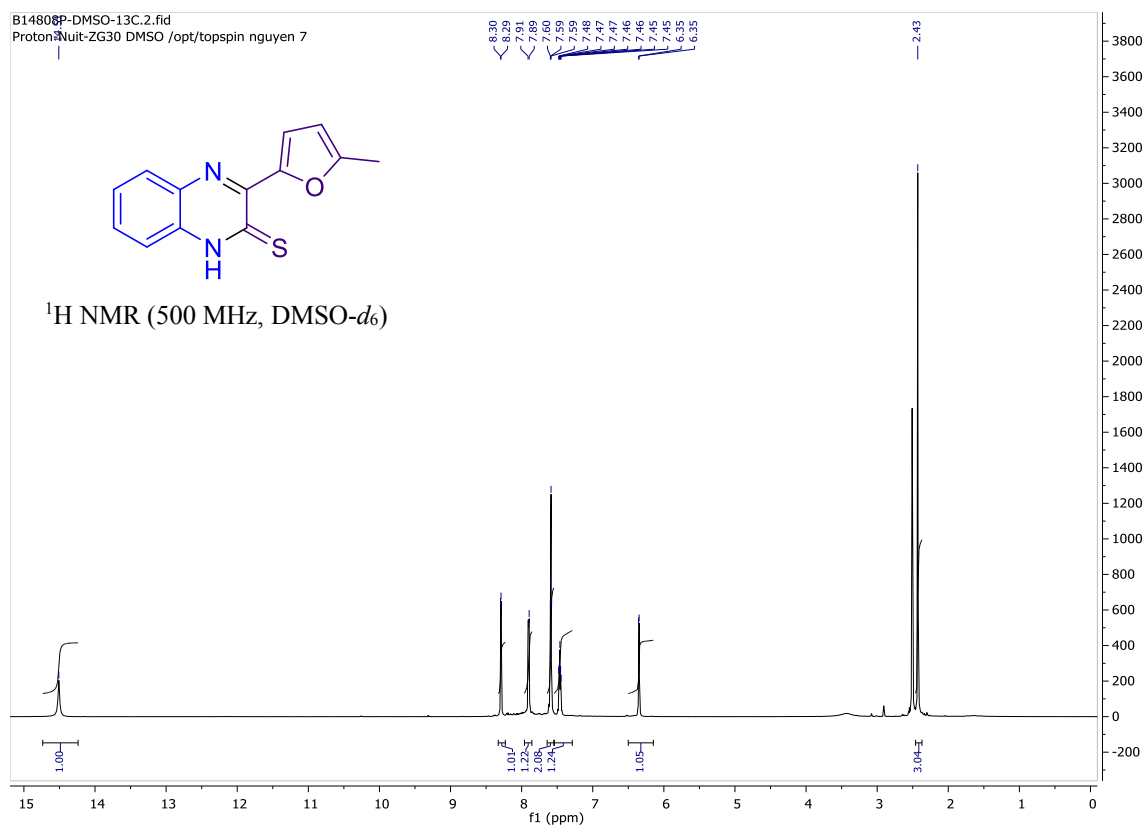
6,7-Dimethyl-3-(pyridin-4-yl)quinoxaline-2(1H)-thione (3bp)



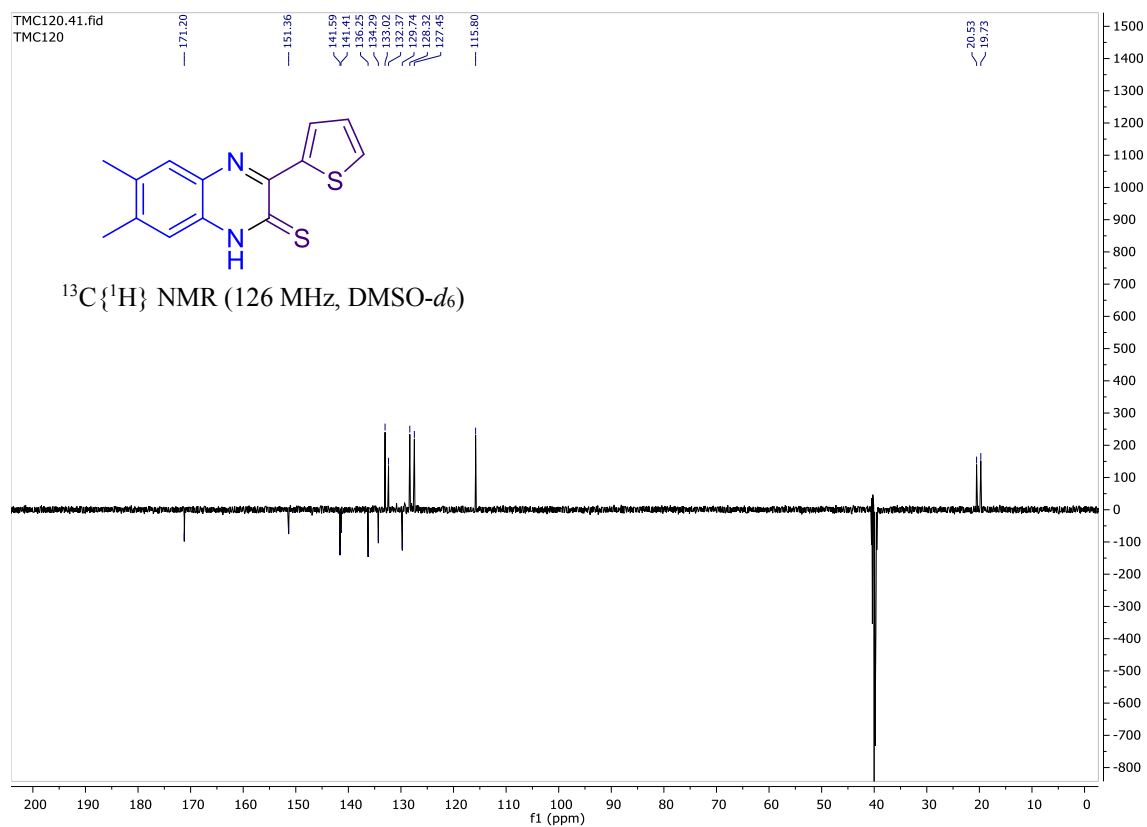
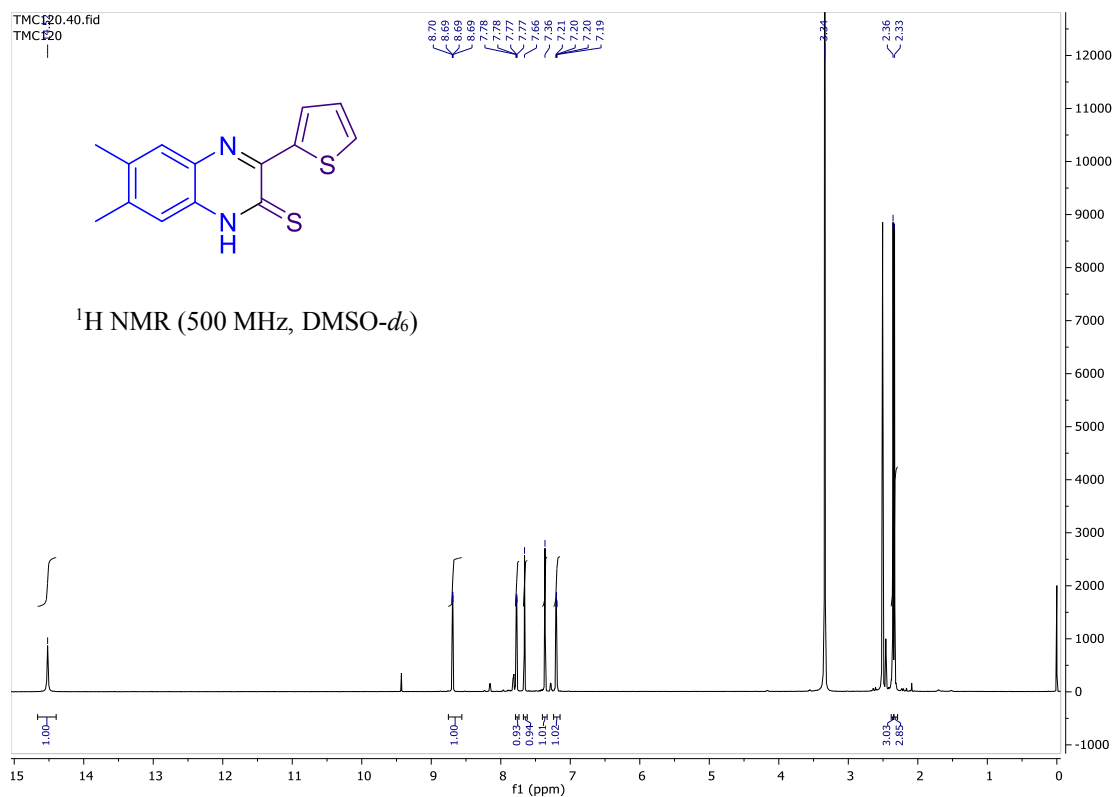
3-(Pyridin-3-yl)quinoxaline-2(1H)-thione (3aq)



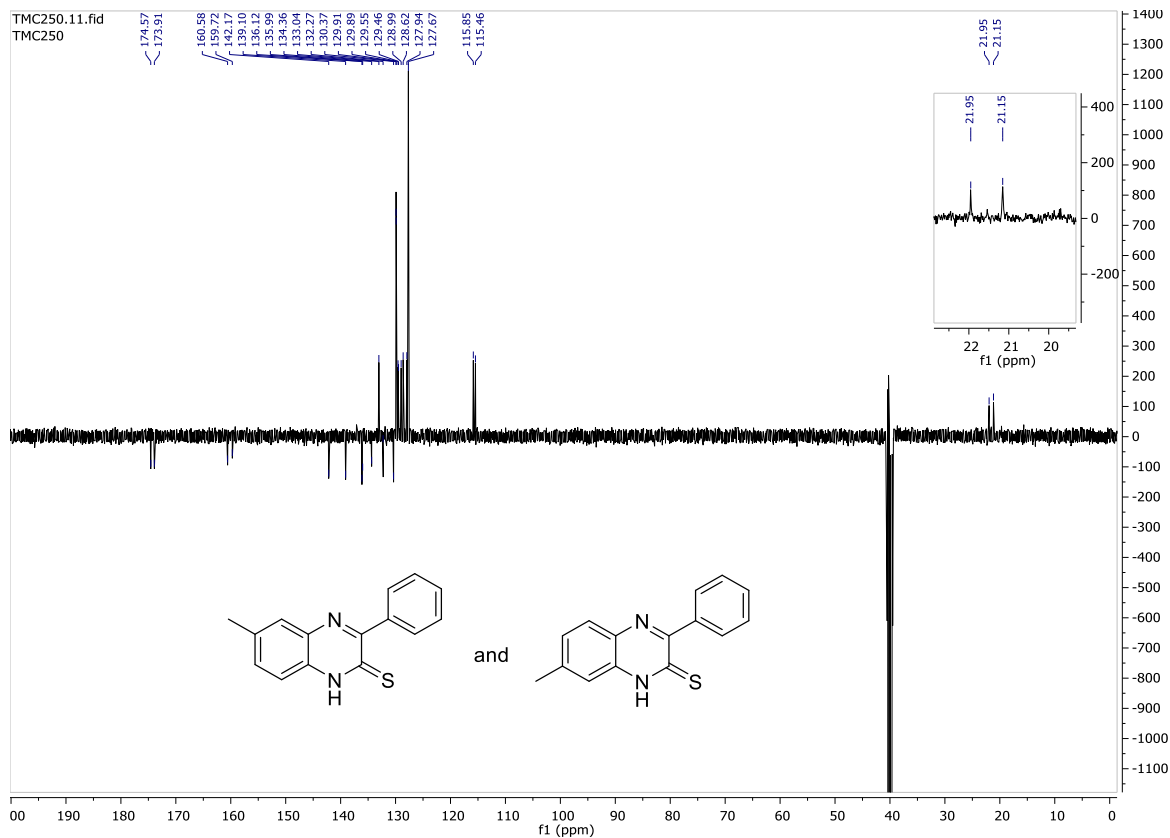
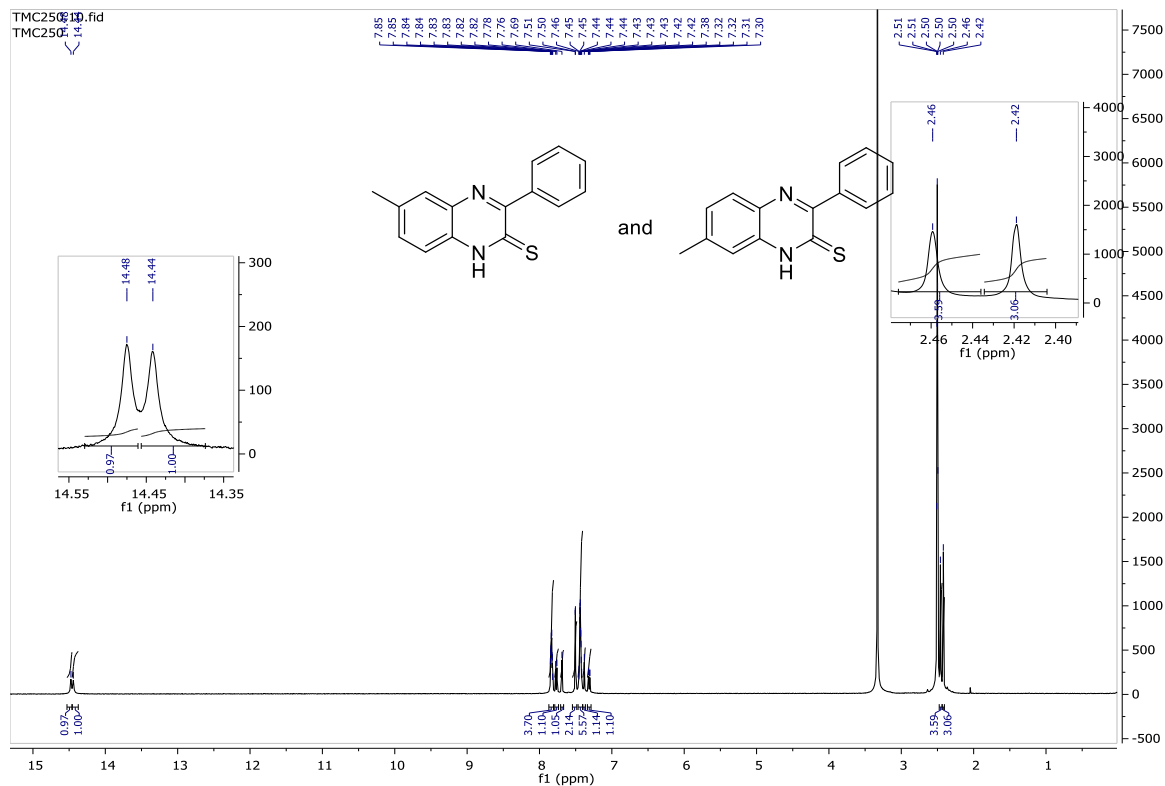
3-(5-Methylfuran-2-yl)quinoxaline-2(1H)-thione (3ar)



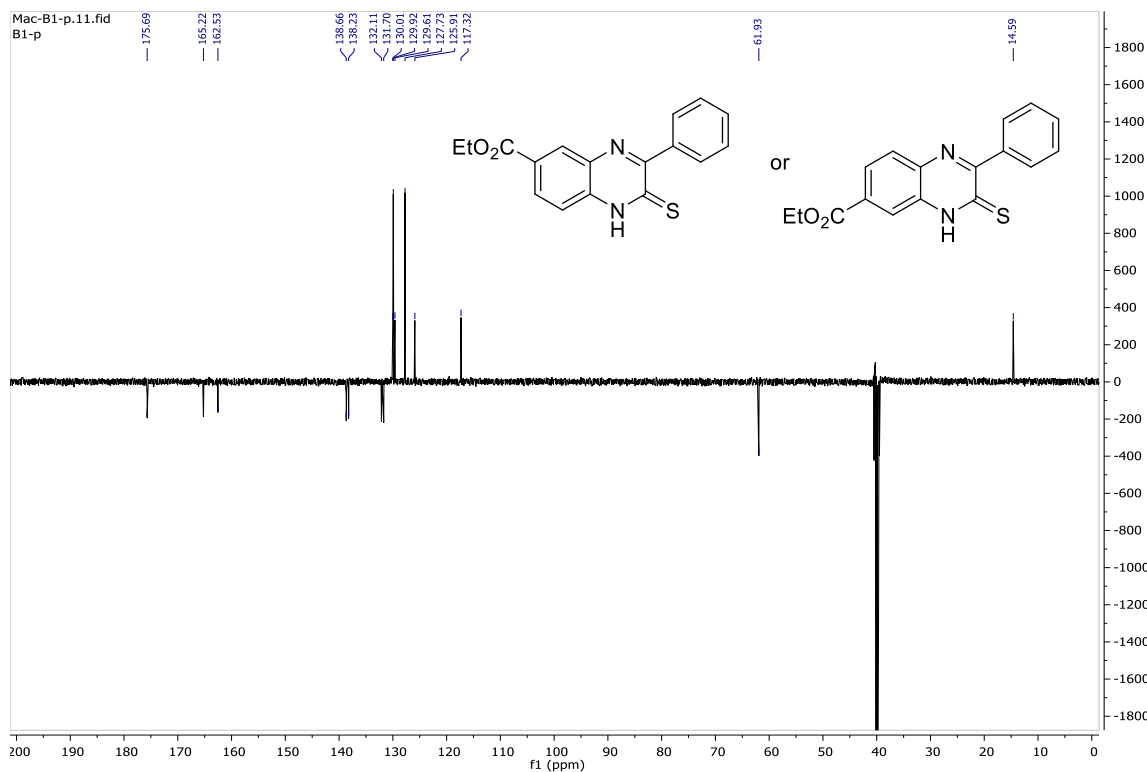
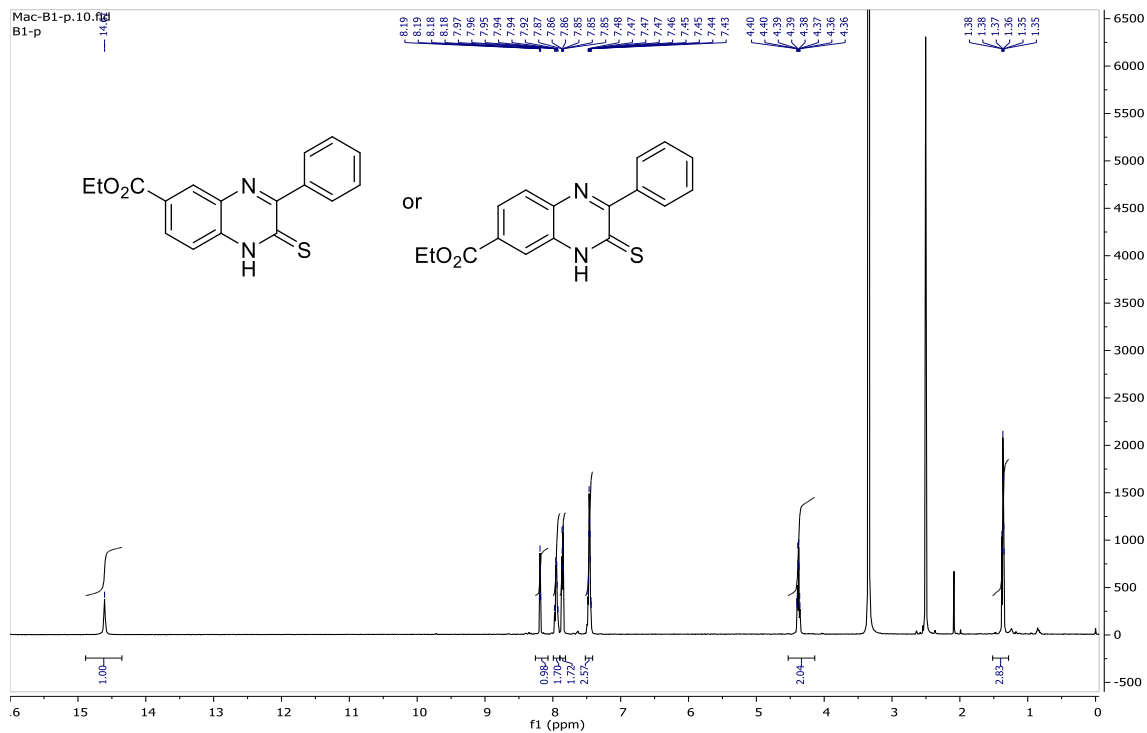
6,7-Dimethyl-3-(thiophen-2-yl)quinoxaline-2(1H)-thione (3bs)



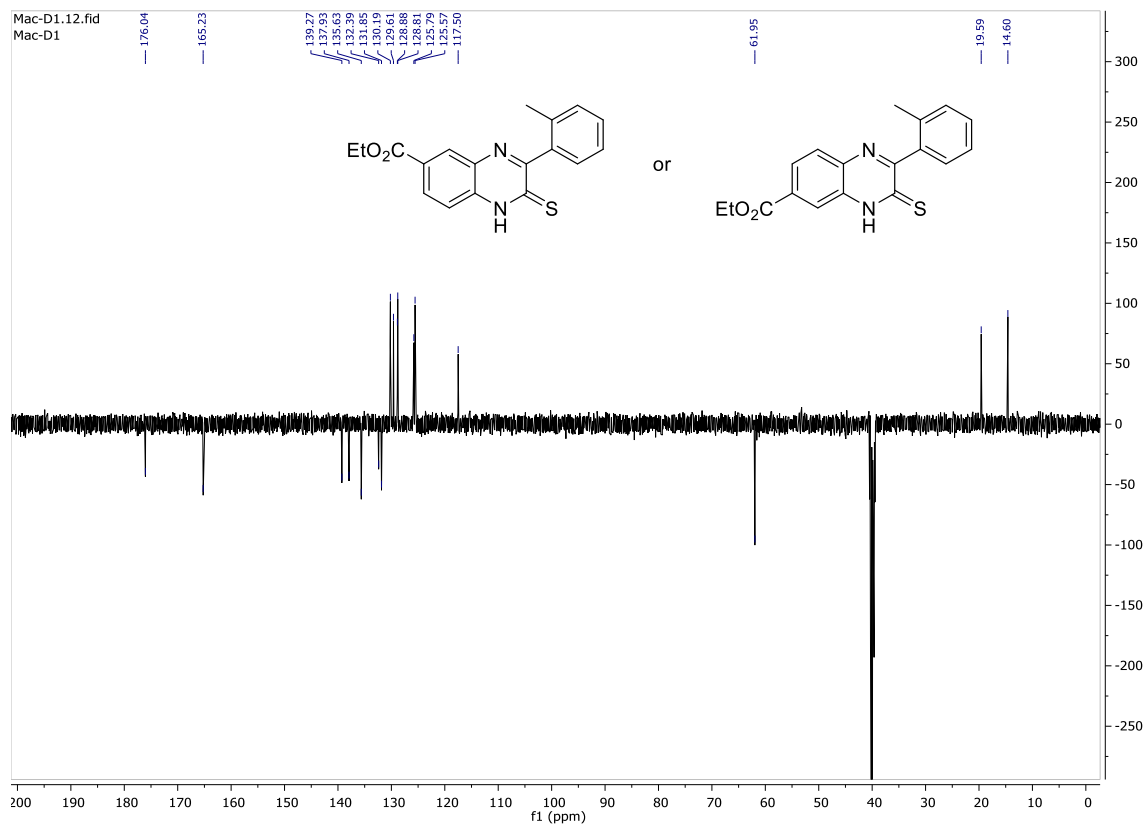
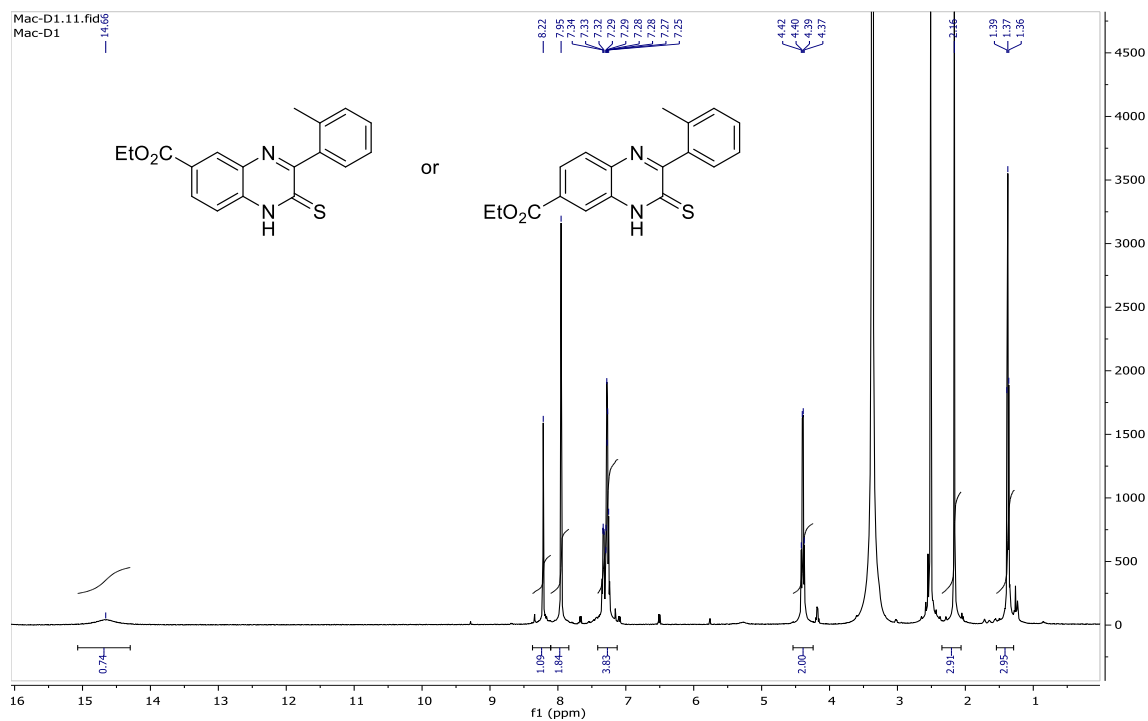
6- and 7- Methyl-3-phenylquinoxaline-2(1H)-thione (3ca)



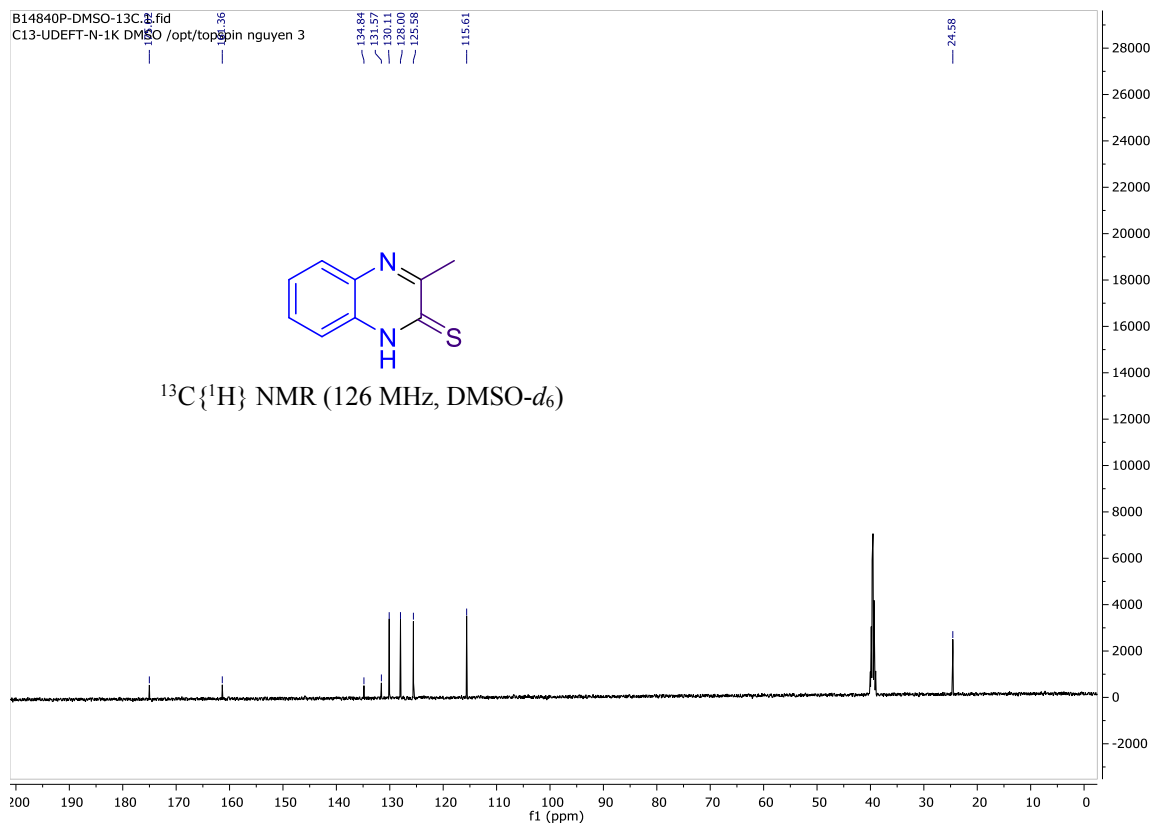
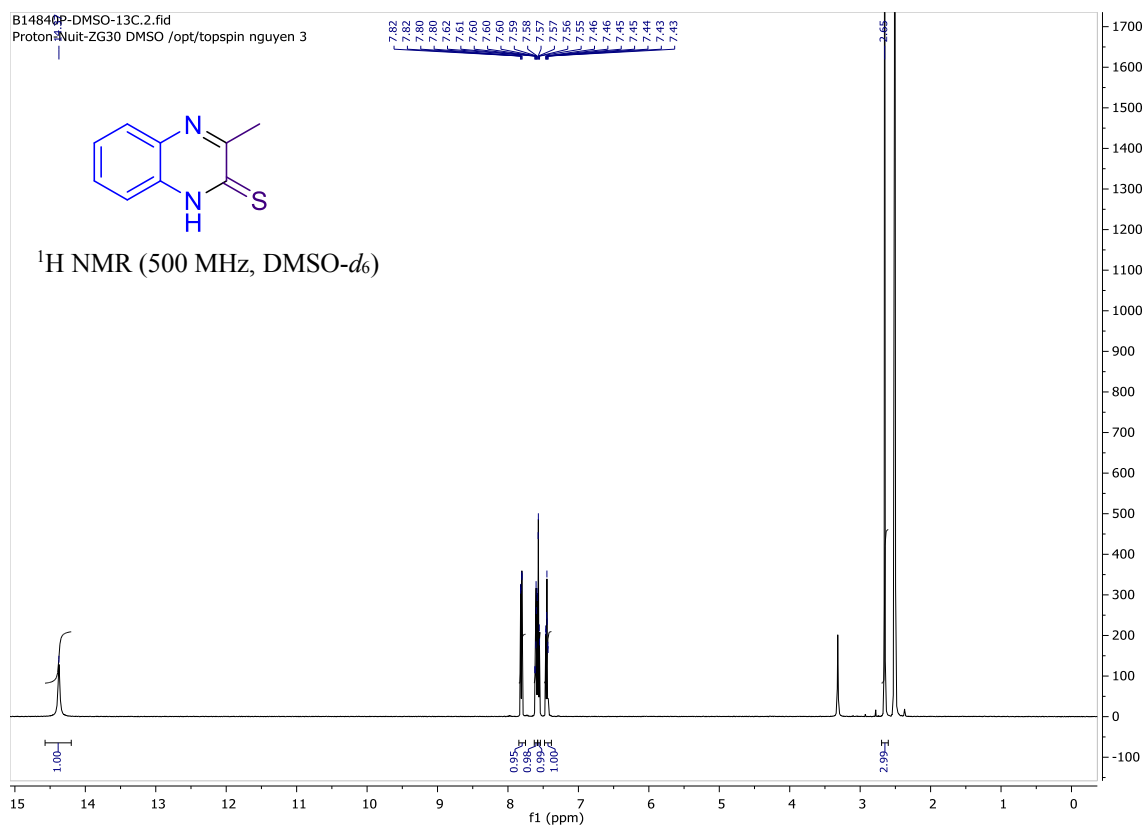
Ethyl 3-phenyl-2-thioxo-1,2-dihydroquinoxaline-6-carboxylate or ethyl 2-phenyl-3-thioxo-3,4-dihydroquinoxaline-6-carboxylate (3ka)



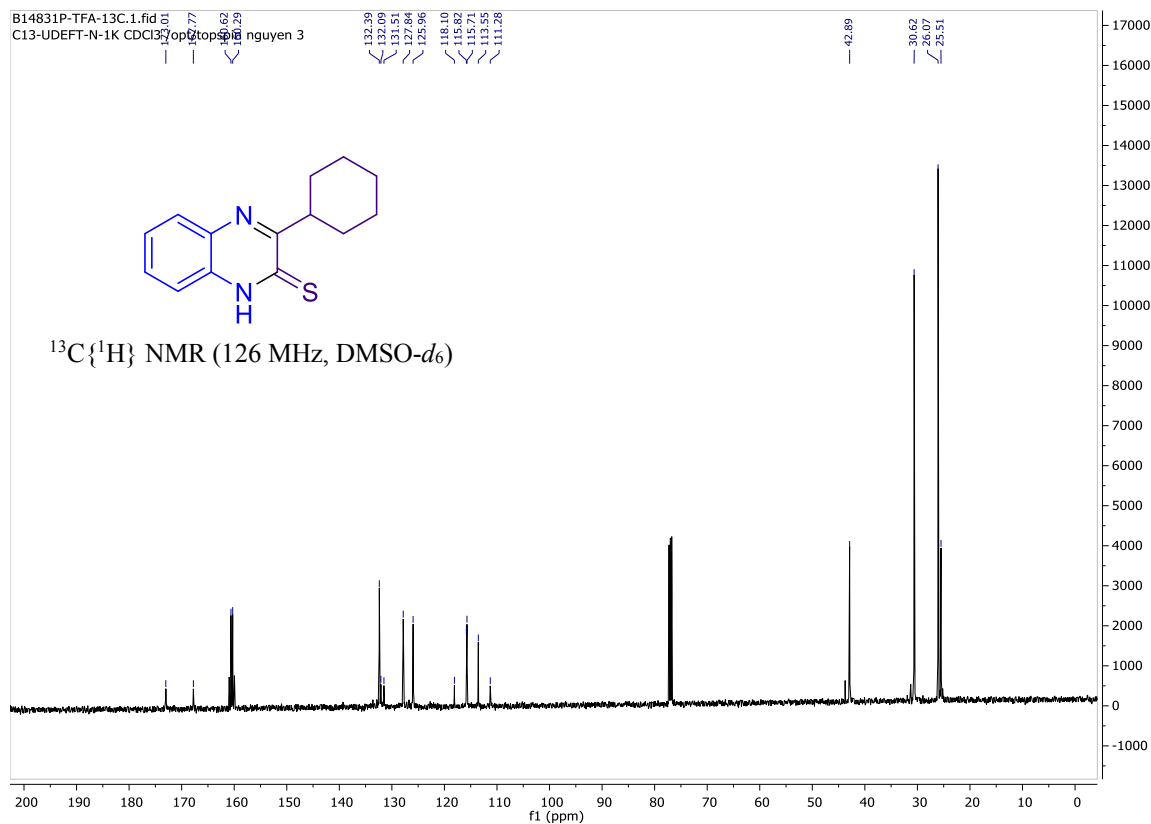
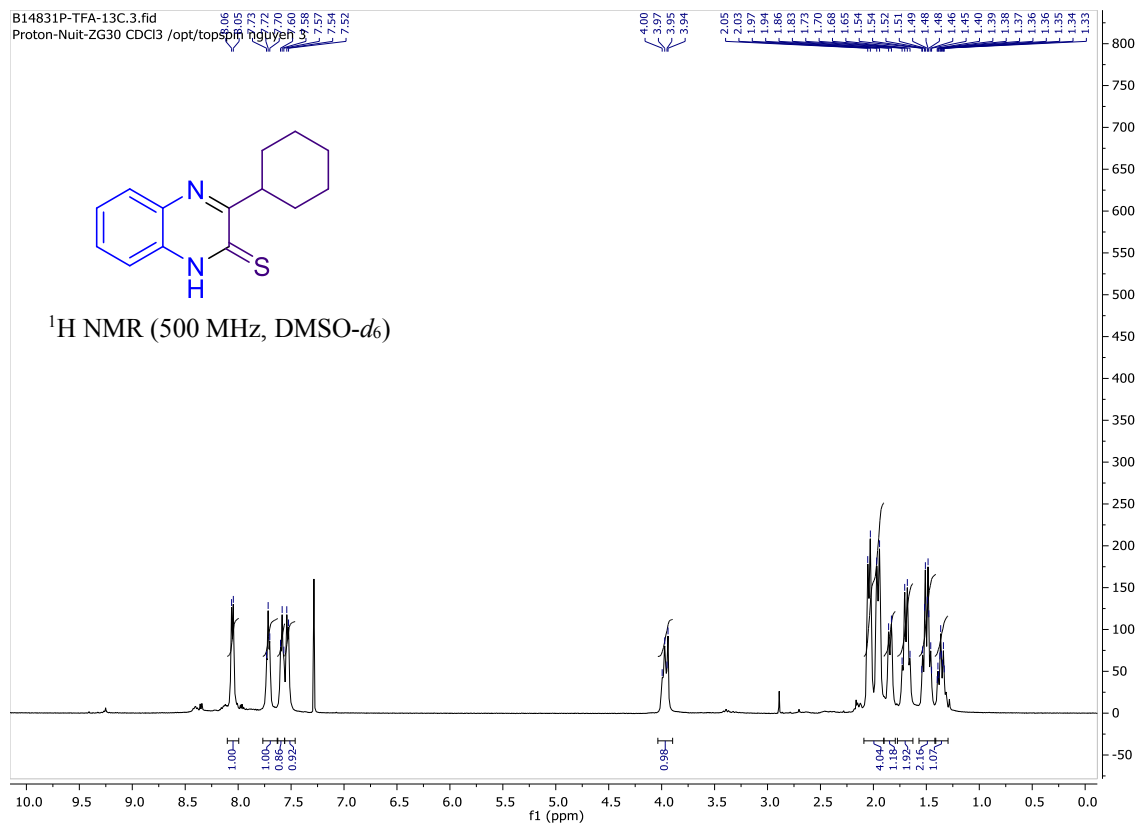
Ethyl 2-thioxo-3-(o-tolyl)-1,2-dihydroquinoxaline-6-carboxylate /or ethyl 3-thioxo-2-(o-tolyl)-3,4-dihydroquinoxaline-6-carboxylate (3ka)



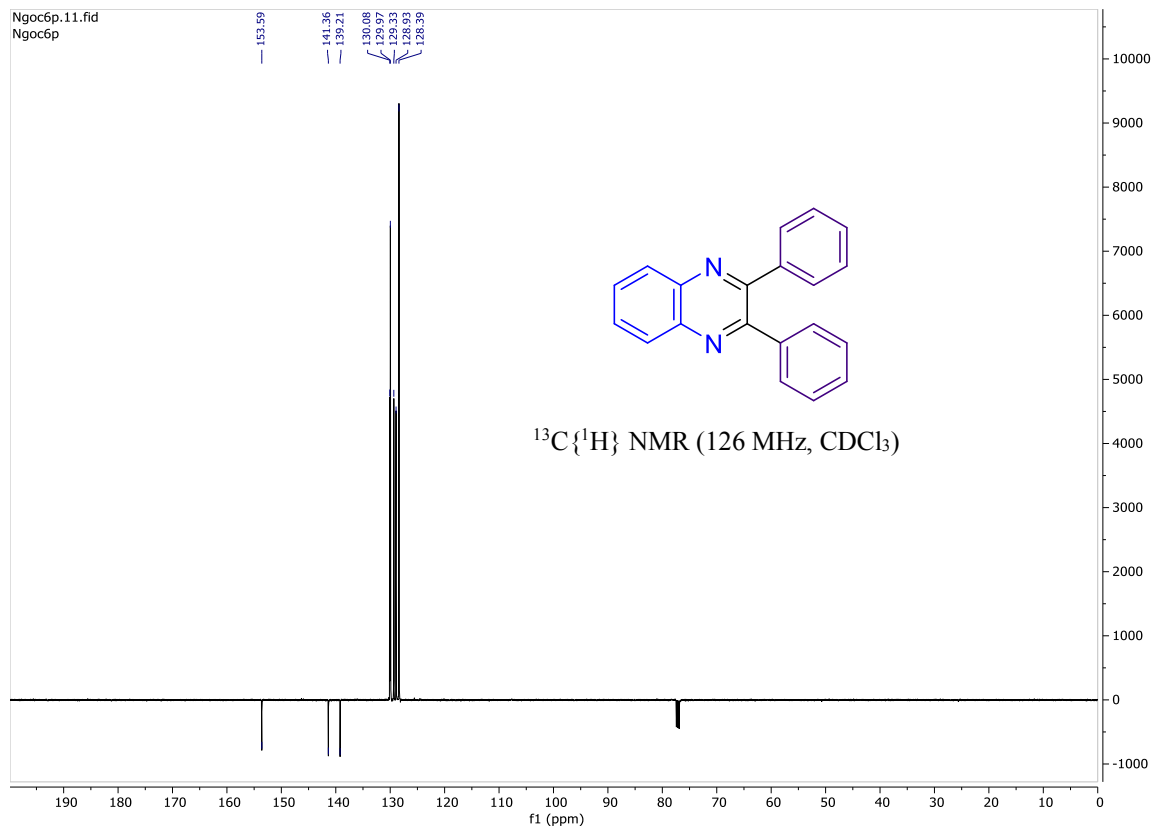
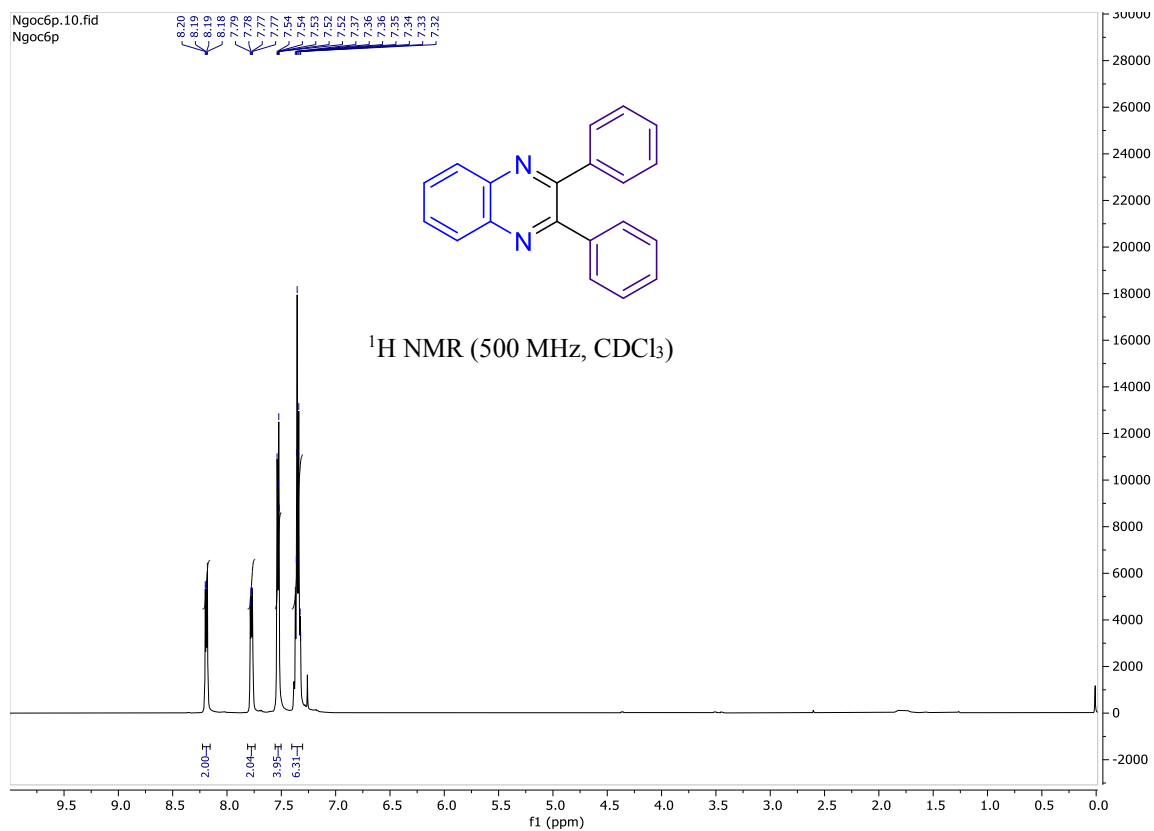
3-Methylquinoxaline-2(1H)-thione (3at)



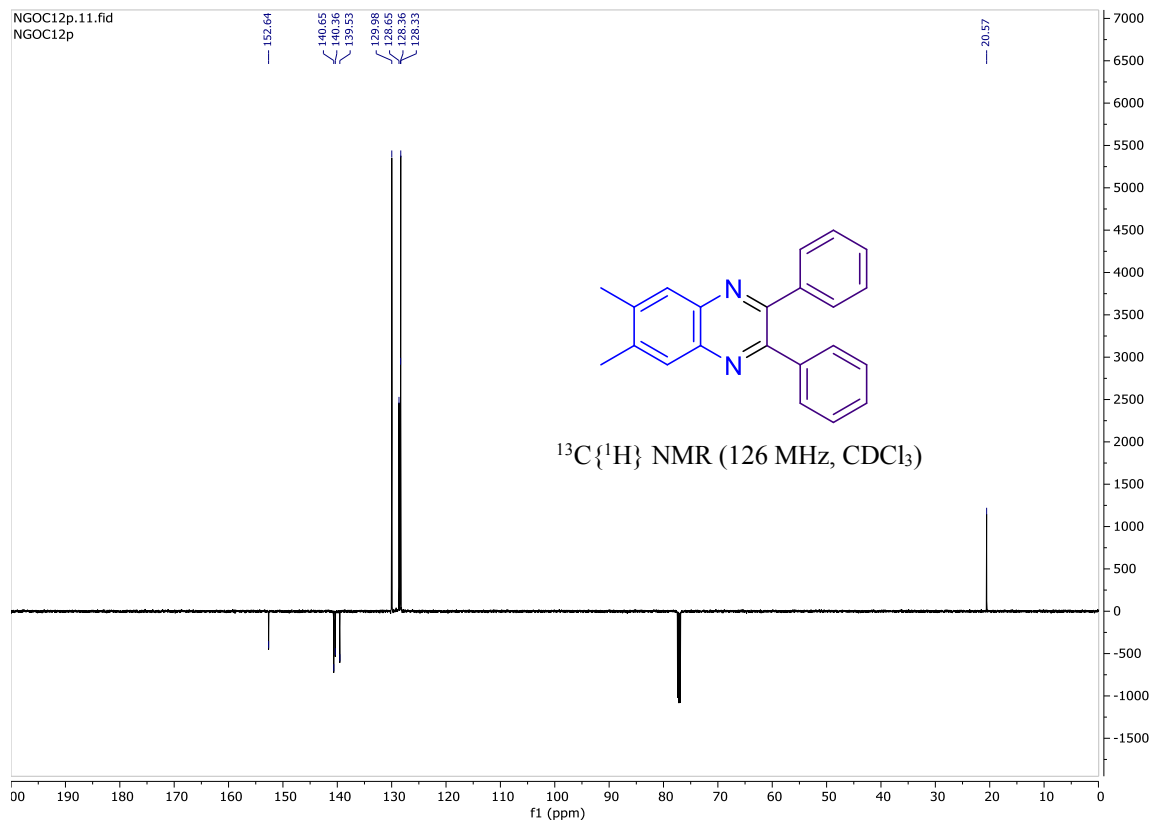
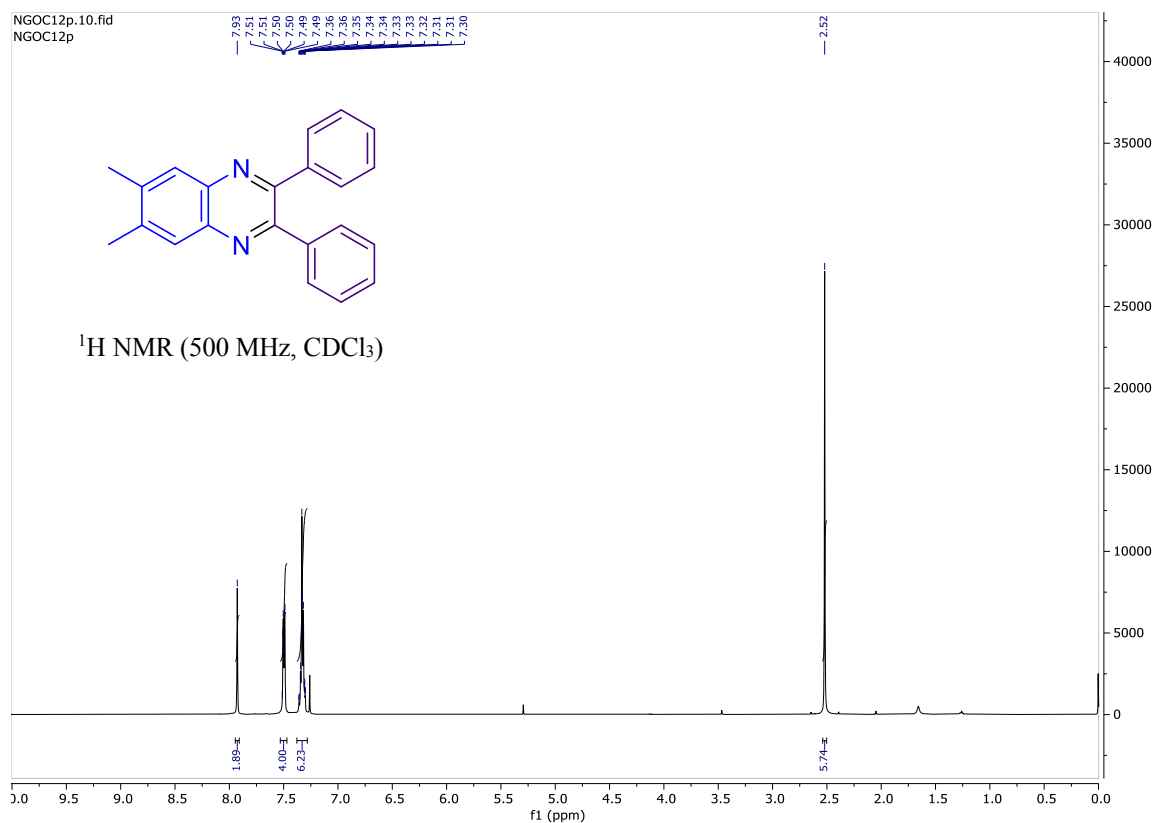
3-Cyclohexylquinoxaline-2(1H)-thione (3au) (500 MHz and 126 MHz, CDCl₃ + TFA)



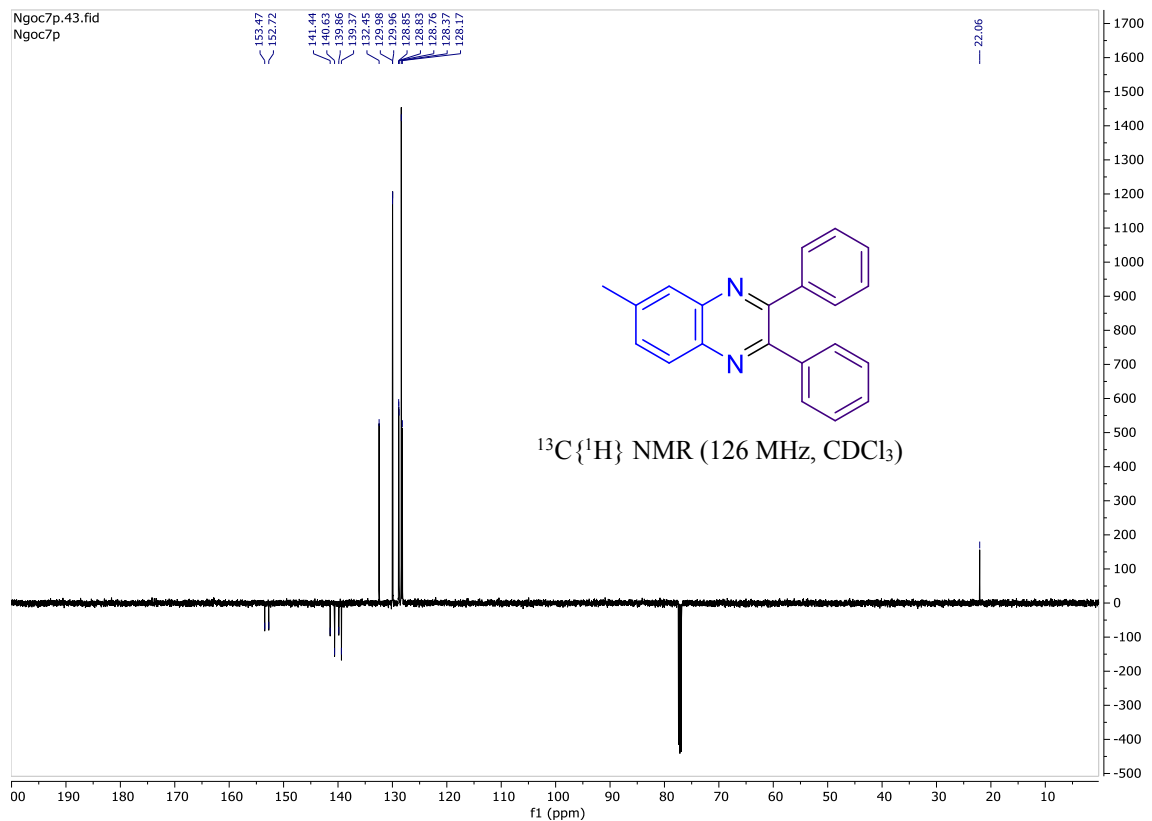
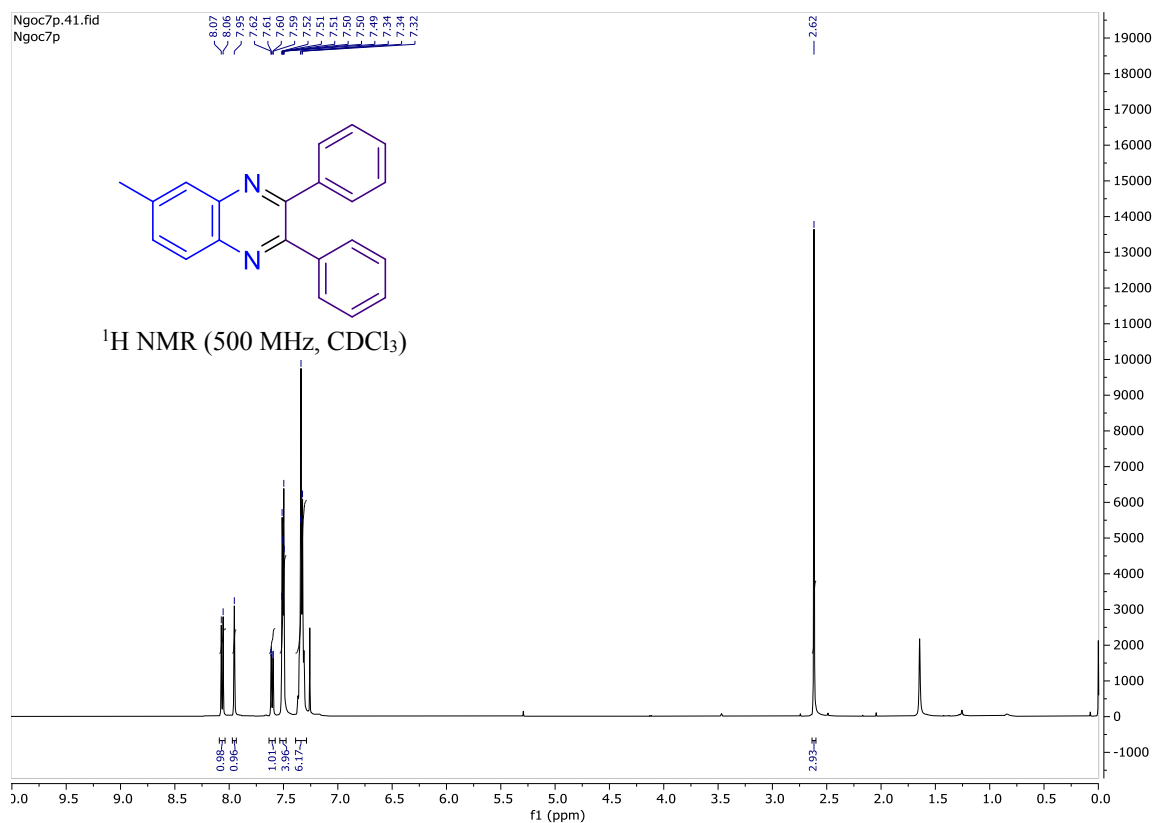
2,3-Diphenylquinoxaline (5aa)



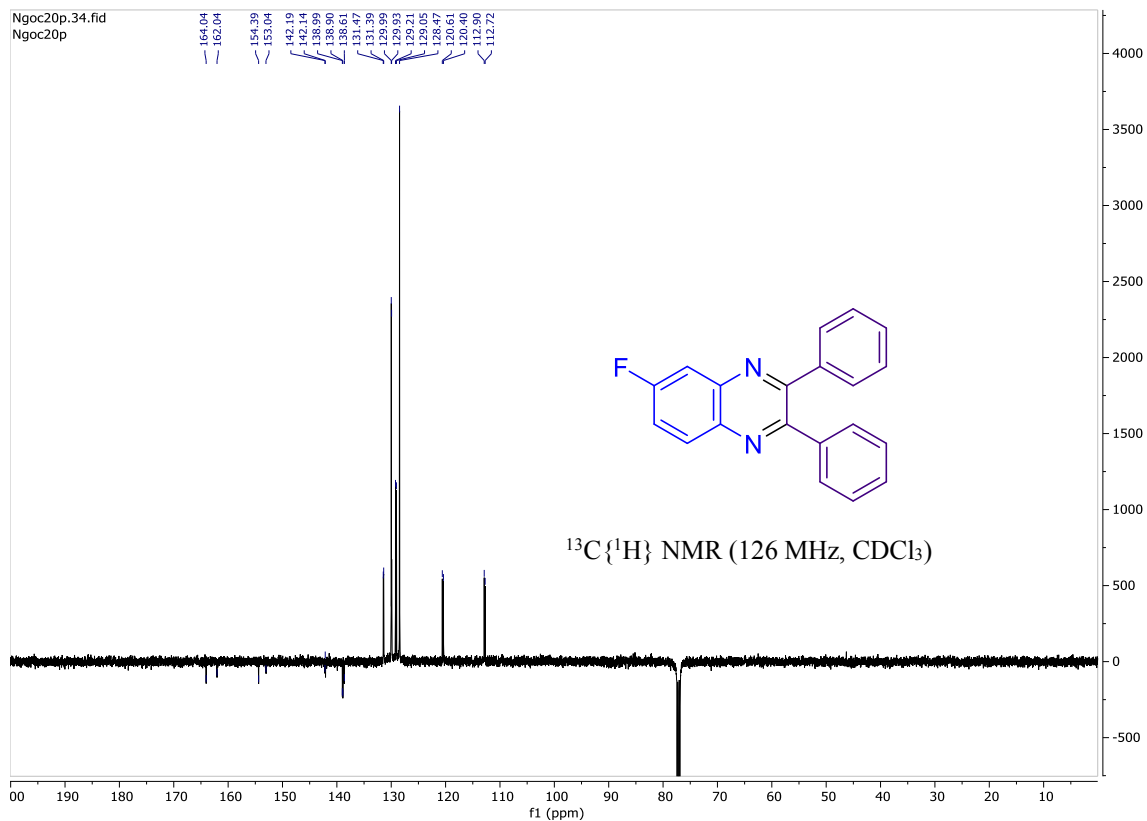
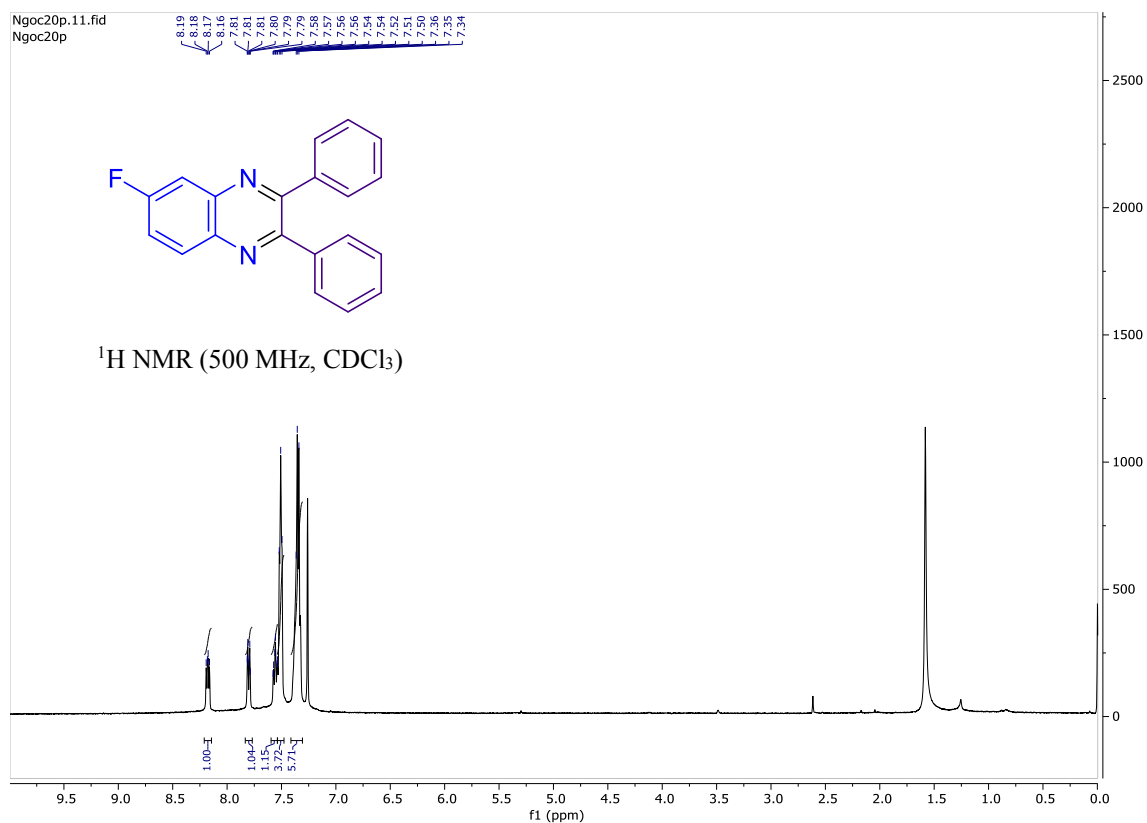
6,7-Dimethyl-2,3-diphenylquinoxaline (5ba)



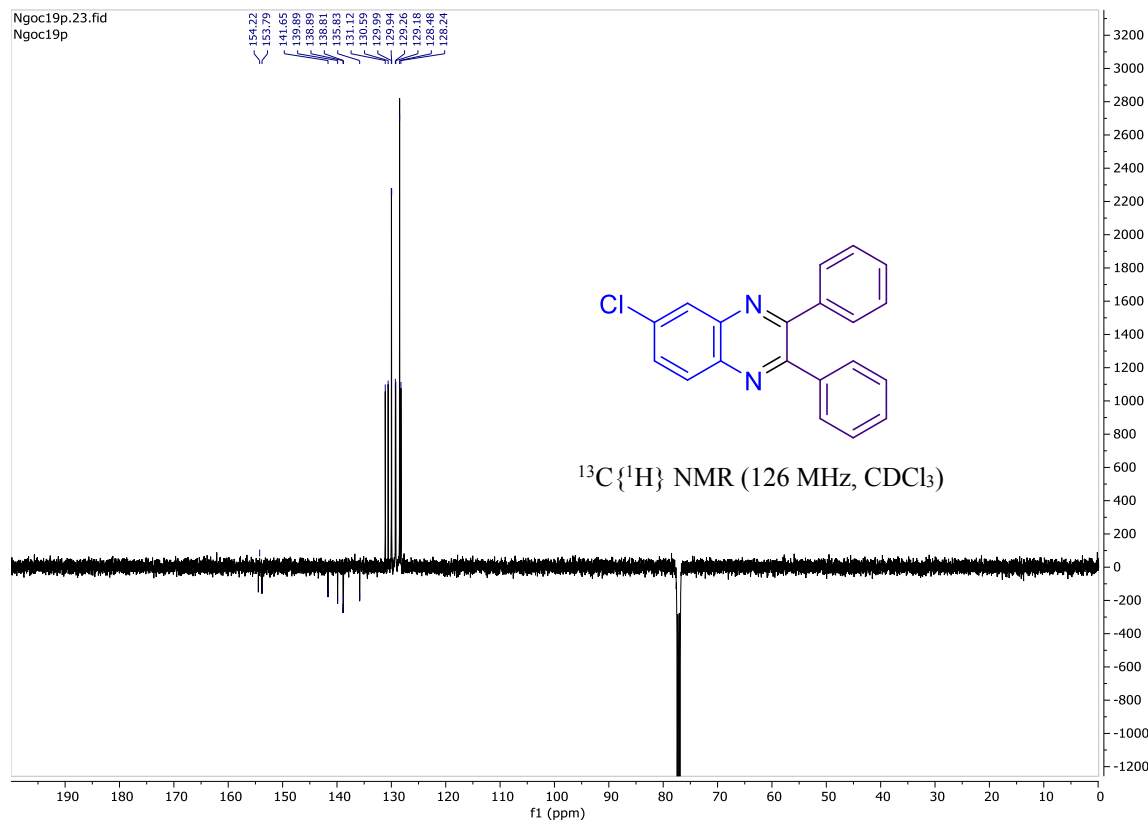
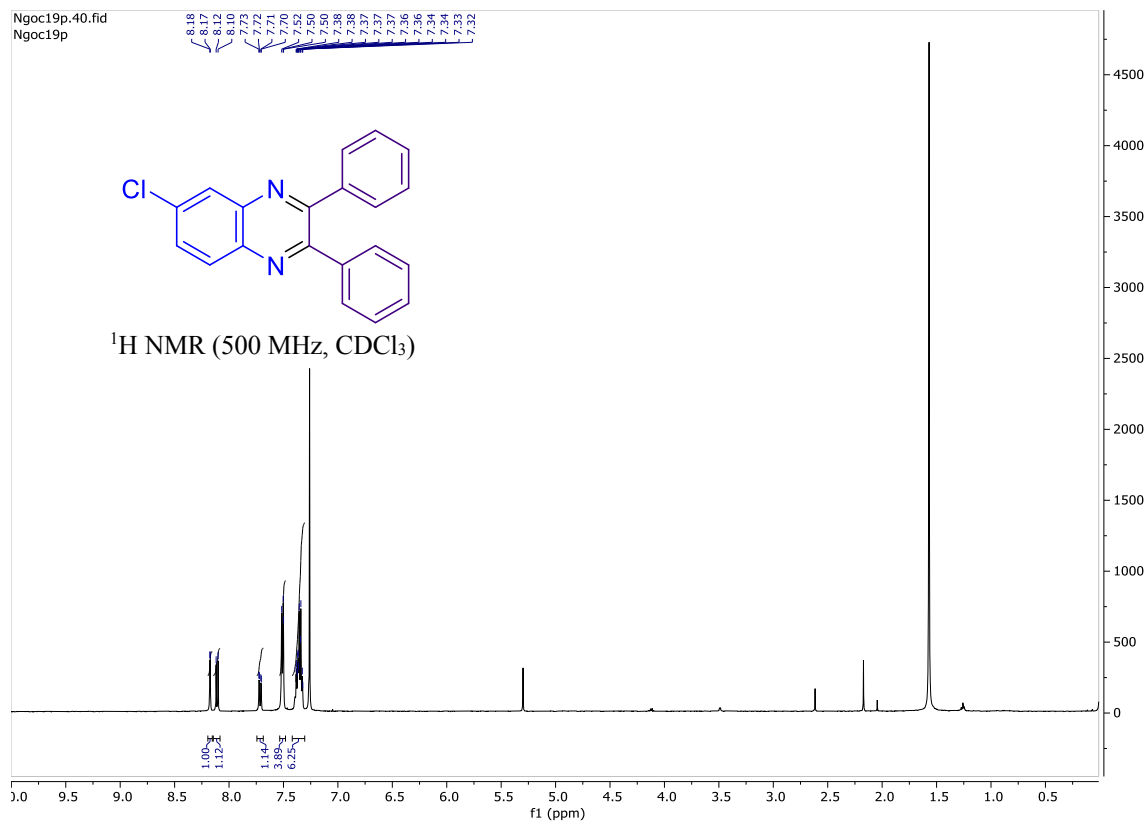
6-Methyl-2,3-diphenylquinoxaline (5ca) (500 MHz and 126MHz, CDCl₃)



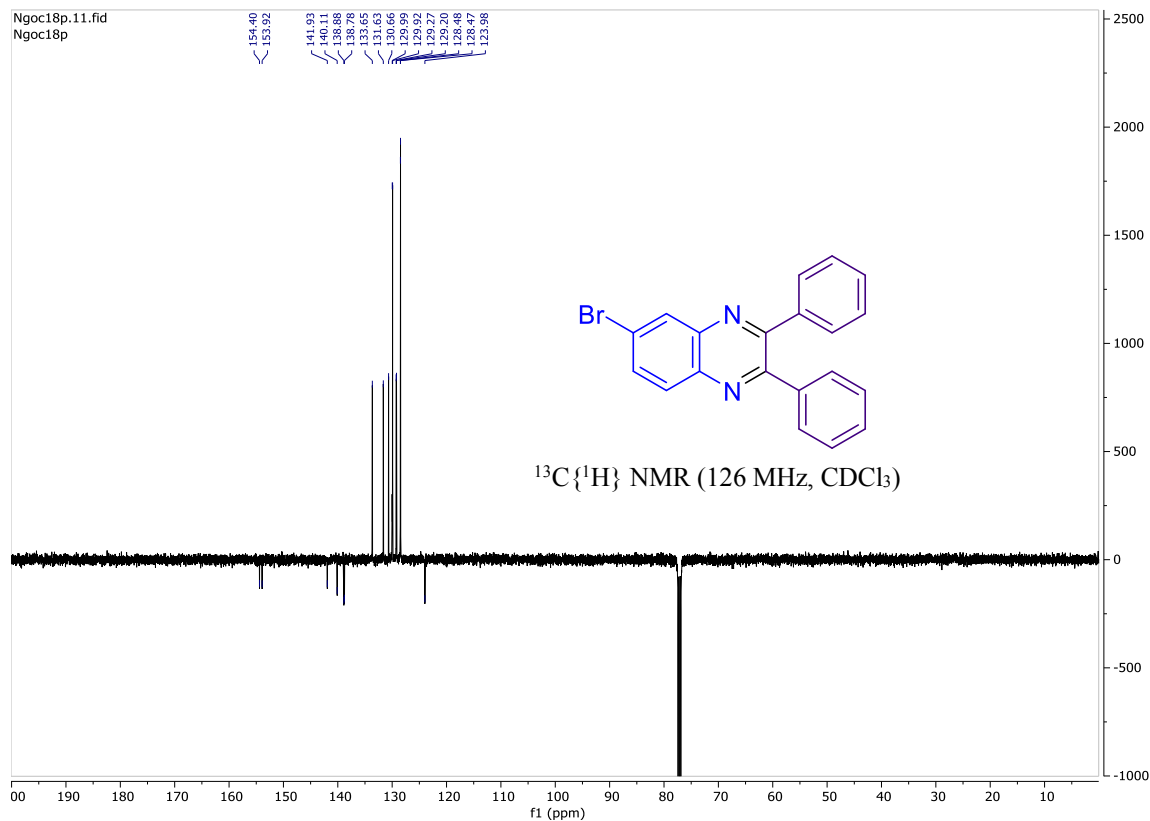
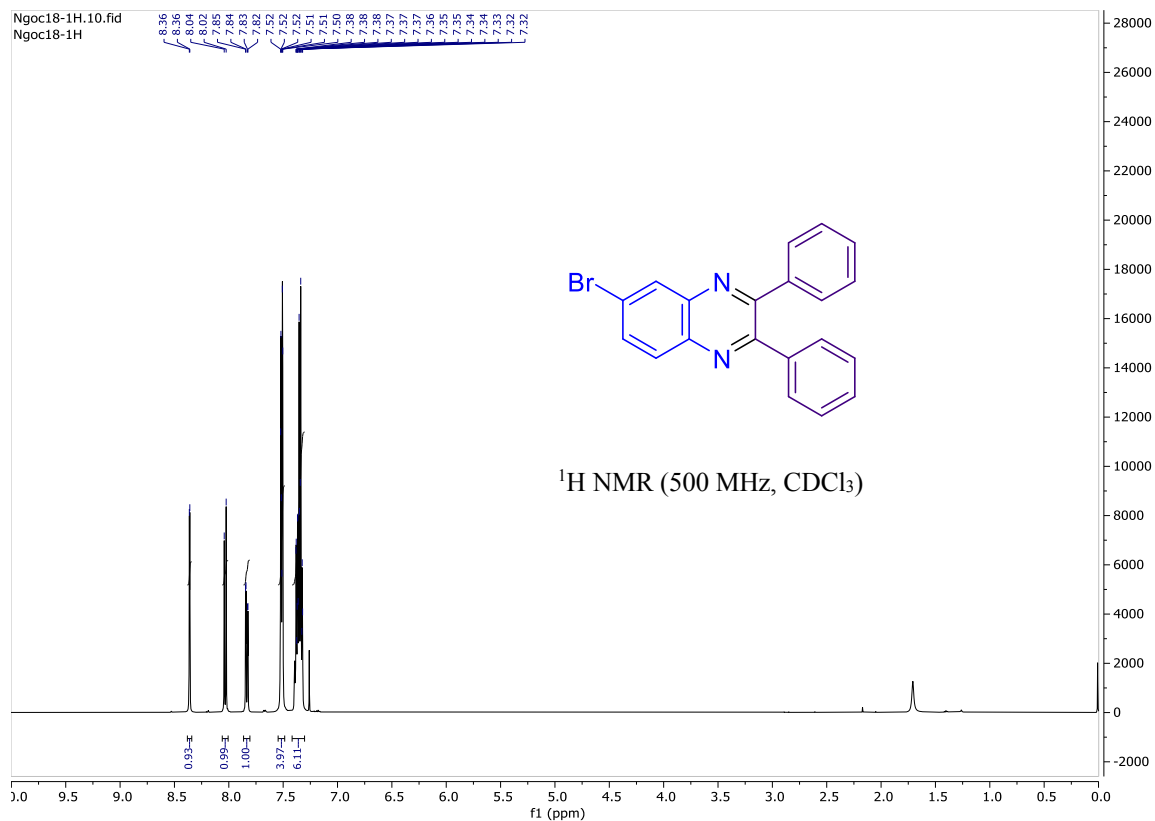
6-Fluoro-2,3-diphenylquinoxaline (5da) (500 Mhz and 126Mhz, CDCl₃)



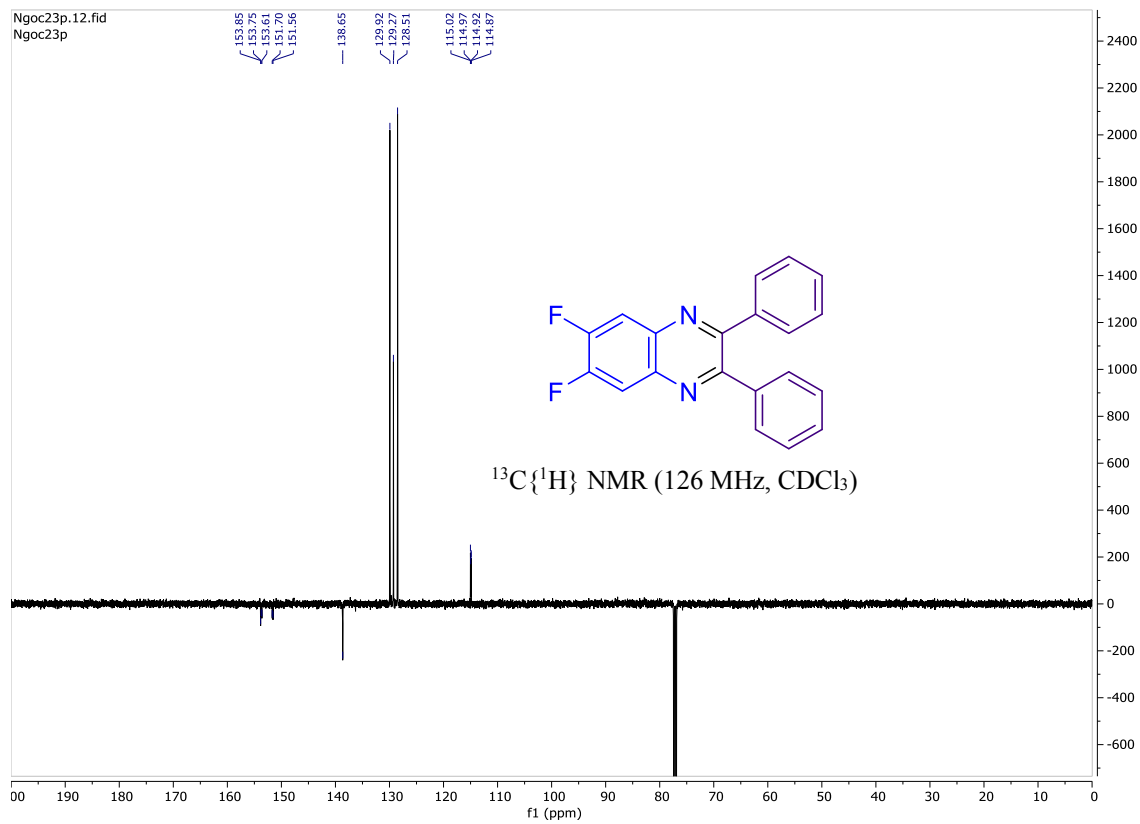
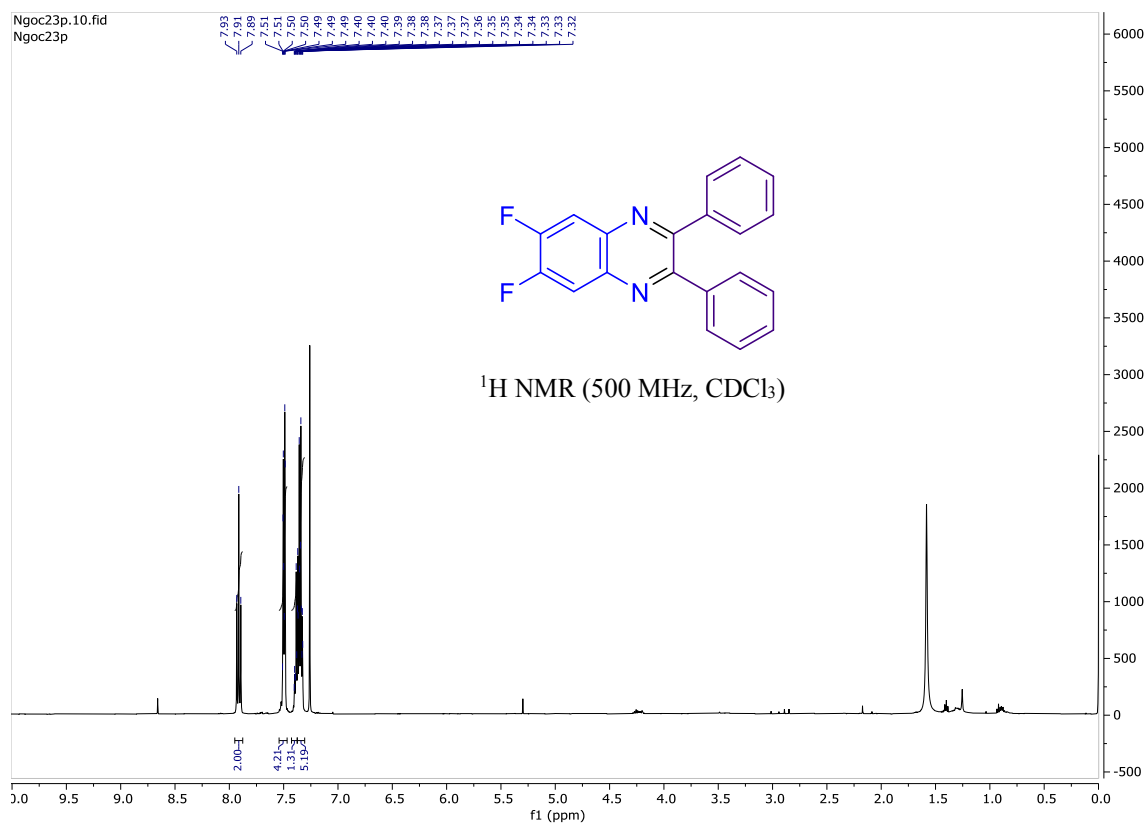
6-Chloro-2,3-diphenylquinoxaline (5ea) (500 MHz and 126MHz, CDCl₃)



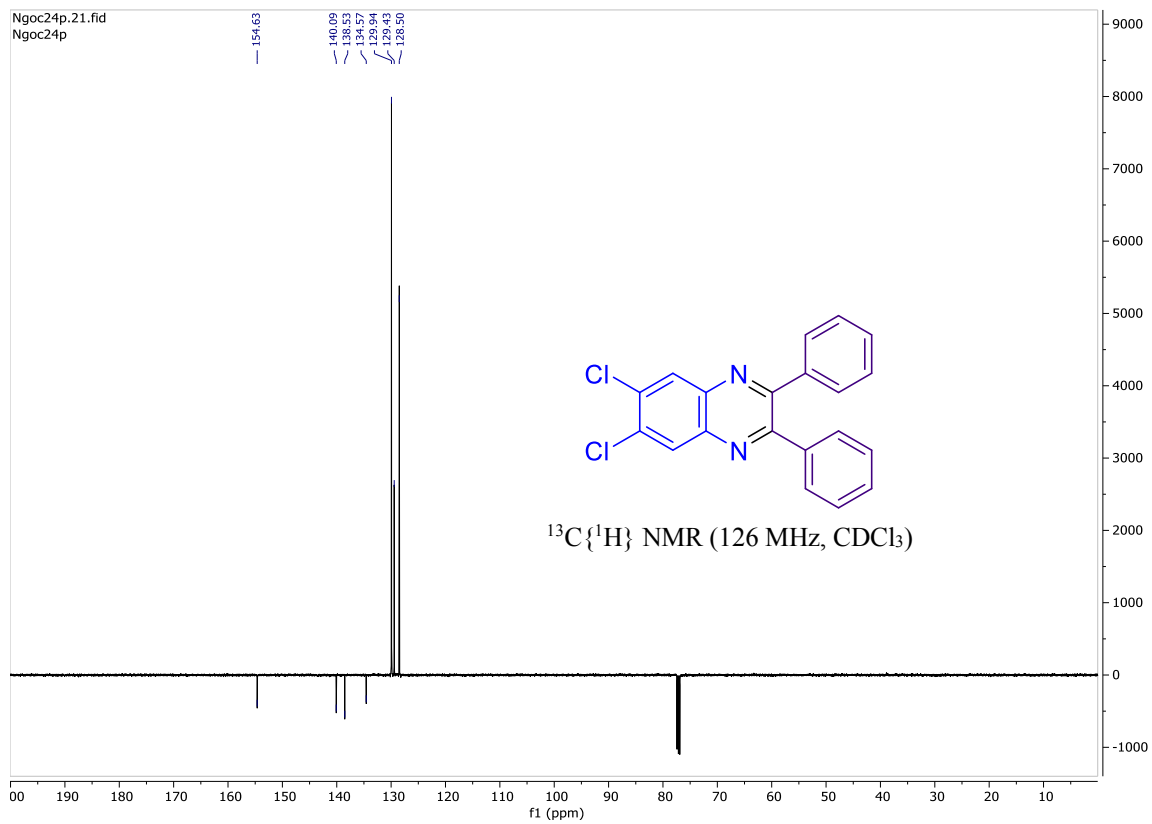
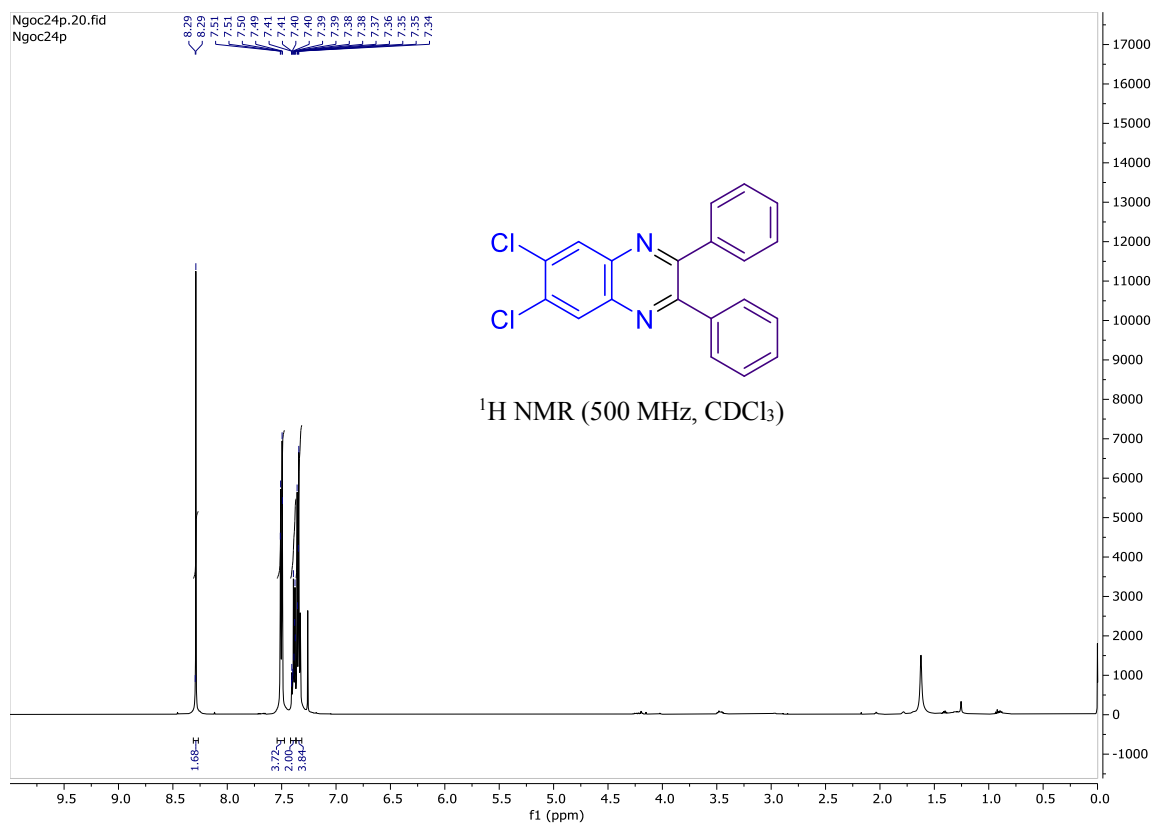
6-Bromo-2,3-diphenylquinoxaline (5fa)



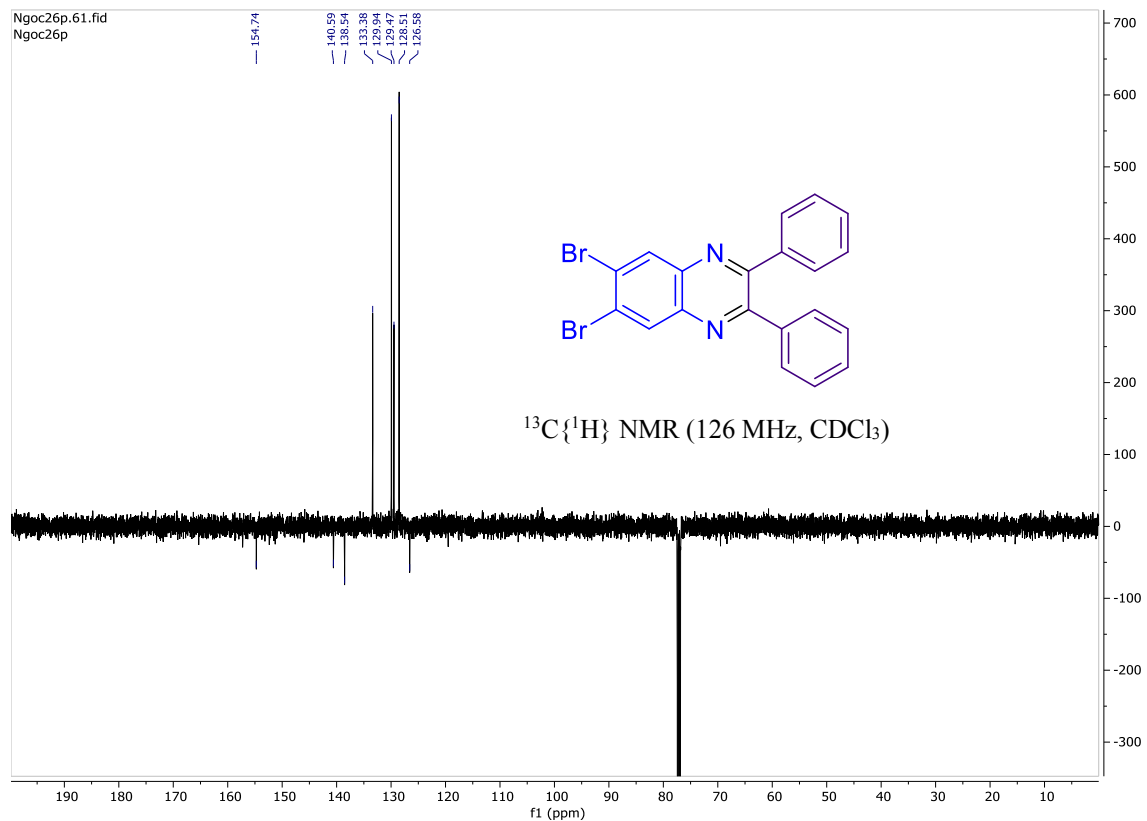
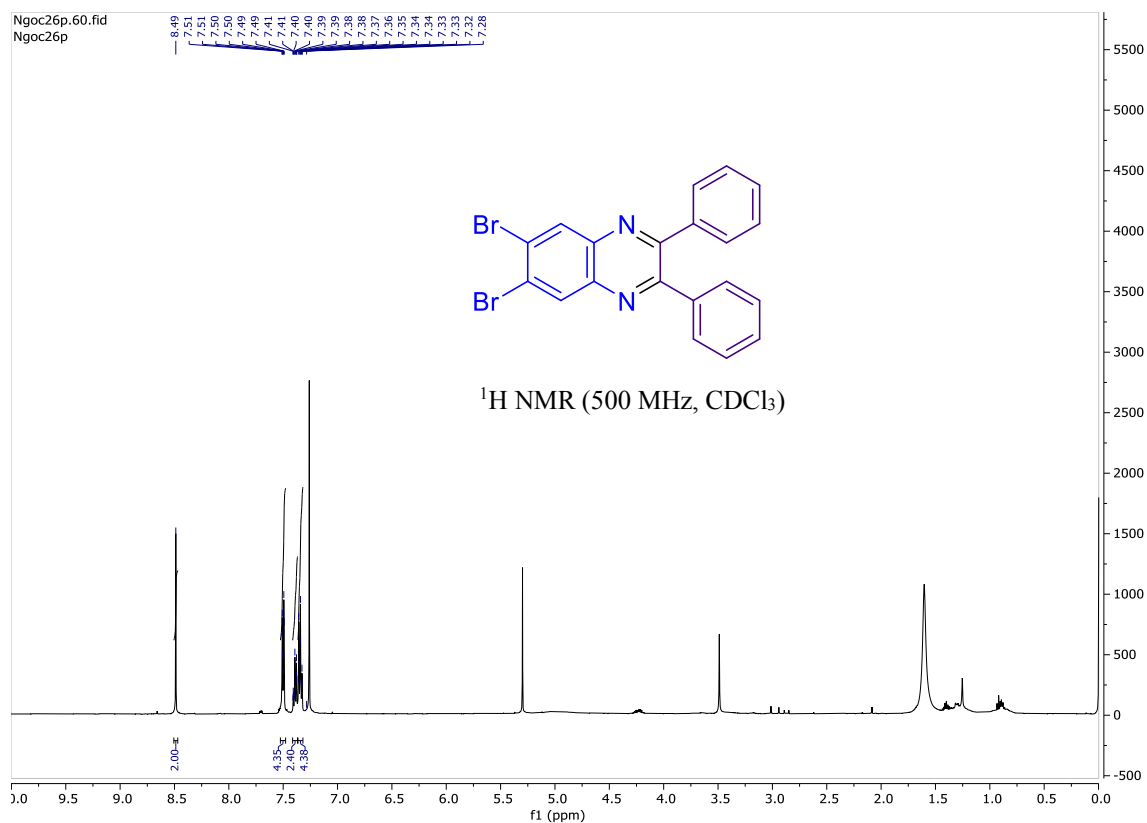
6,7-Difluoro-2,3-diphenylquinoxaline (5ga)



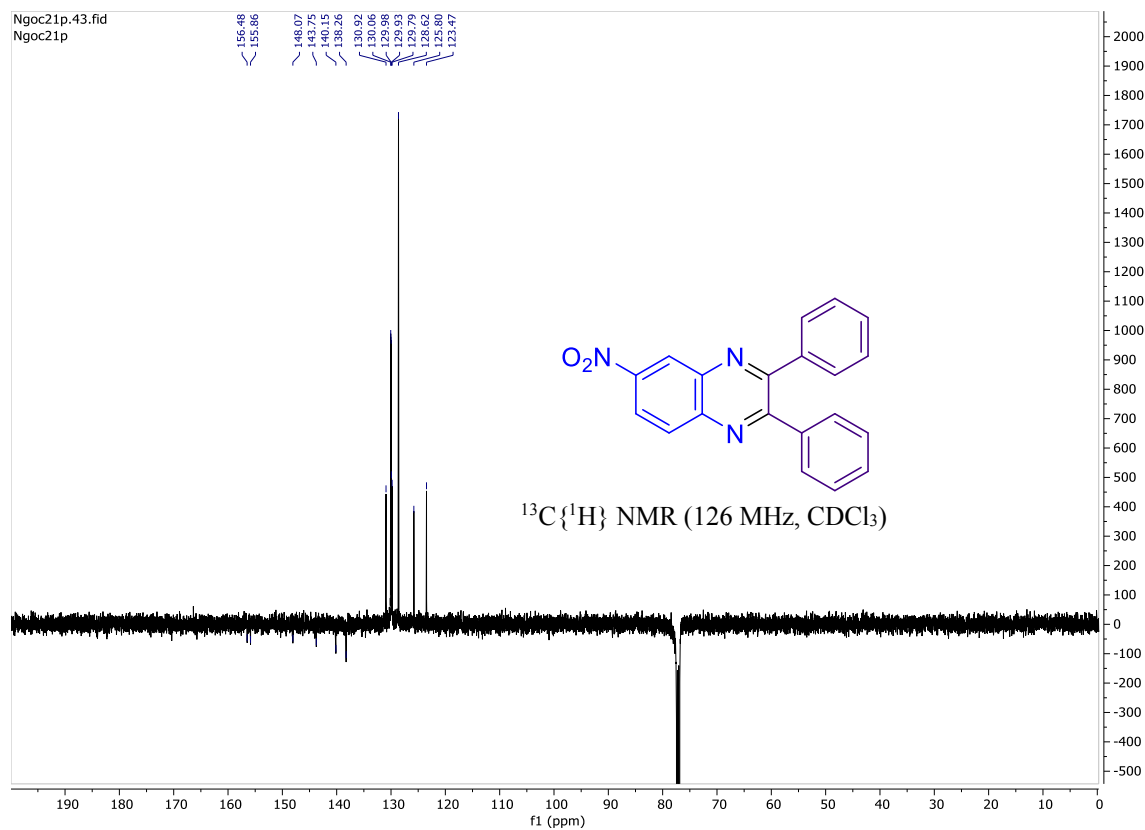
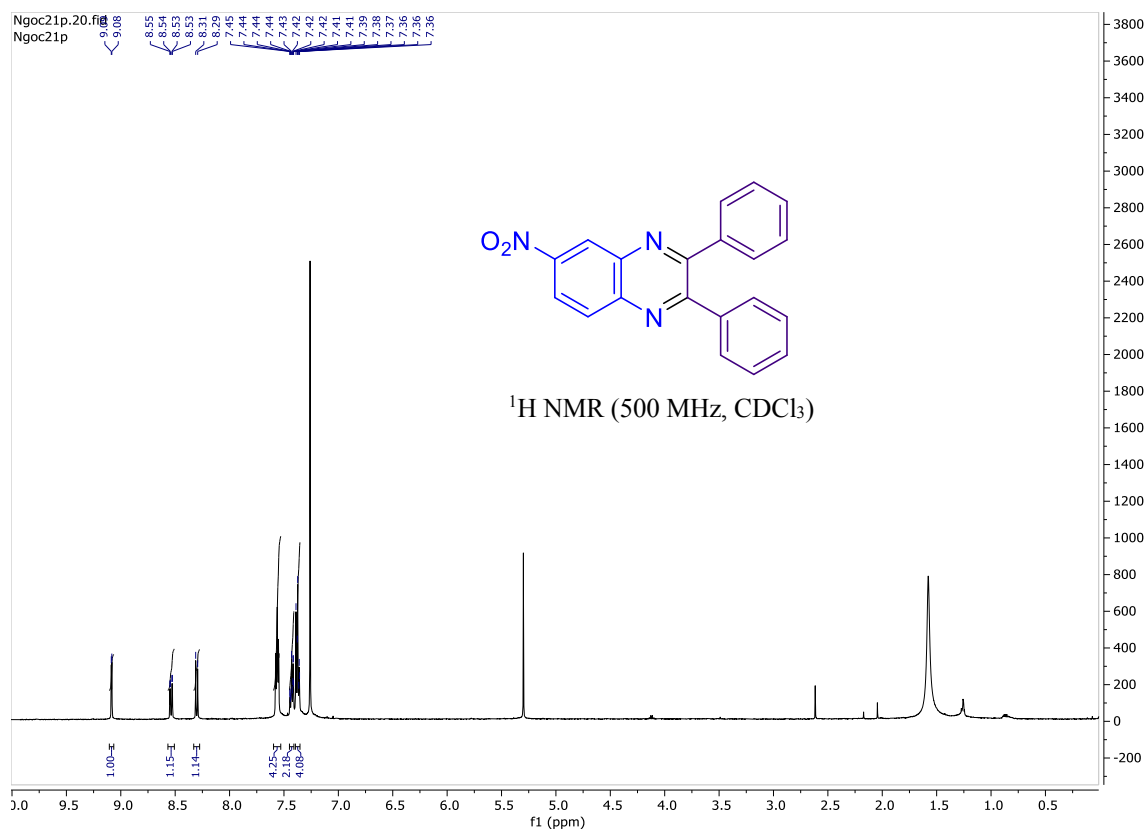
6,7-Dichloro-2,3-diphenylquinoxaline (5ha)



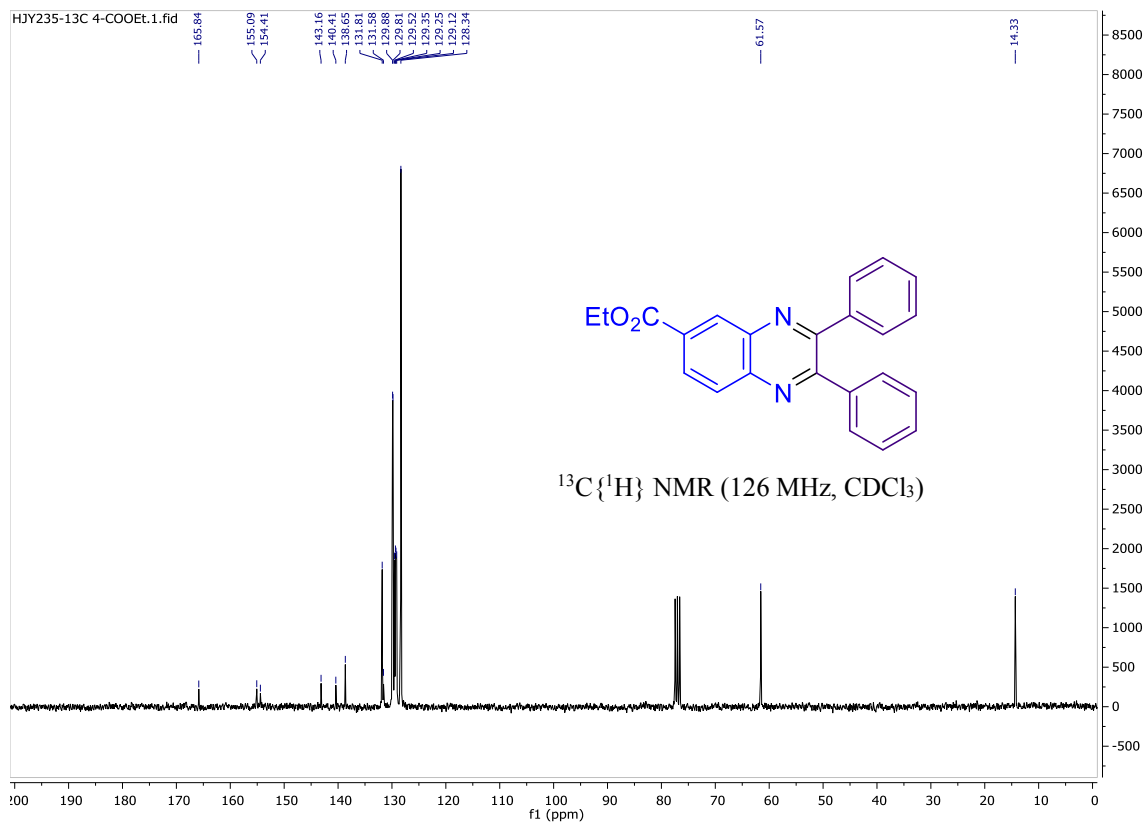
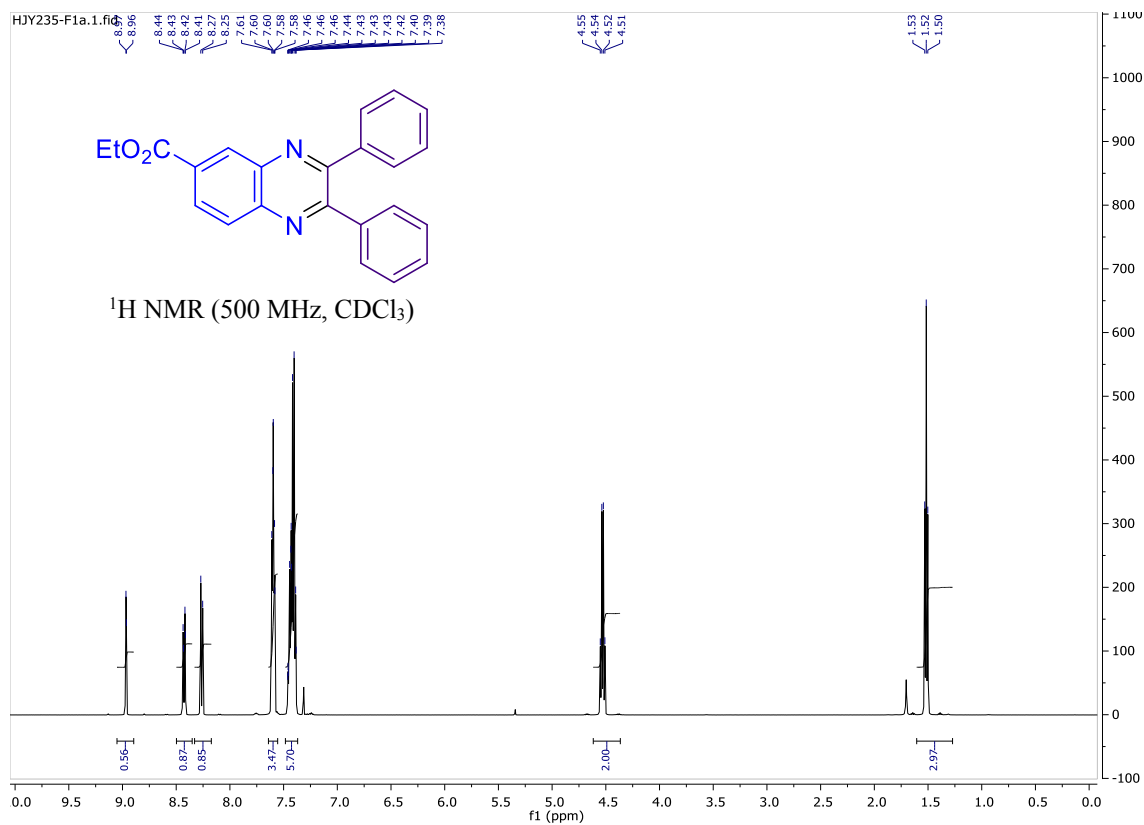
6,7-Dibromo-2,3-diphenylquinoxaline (5ia)



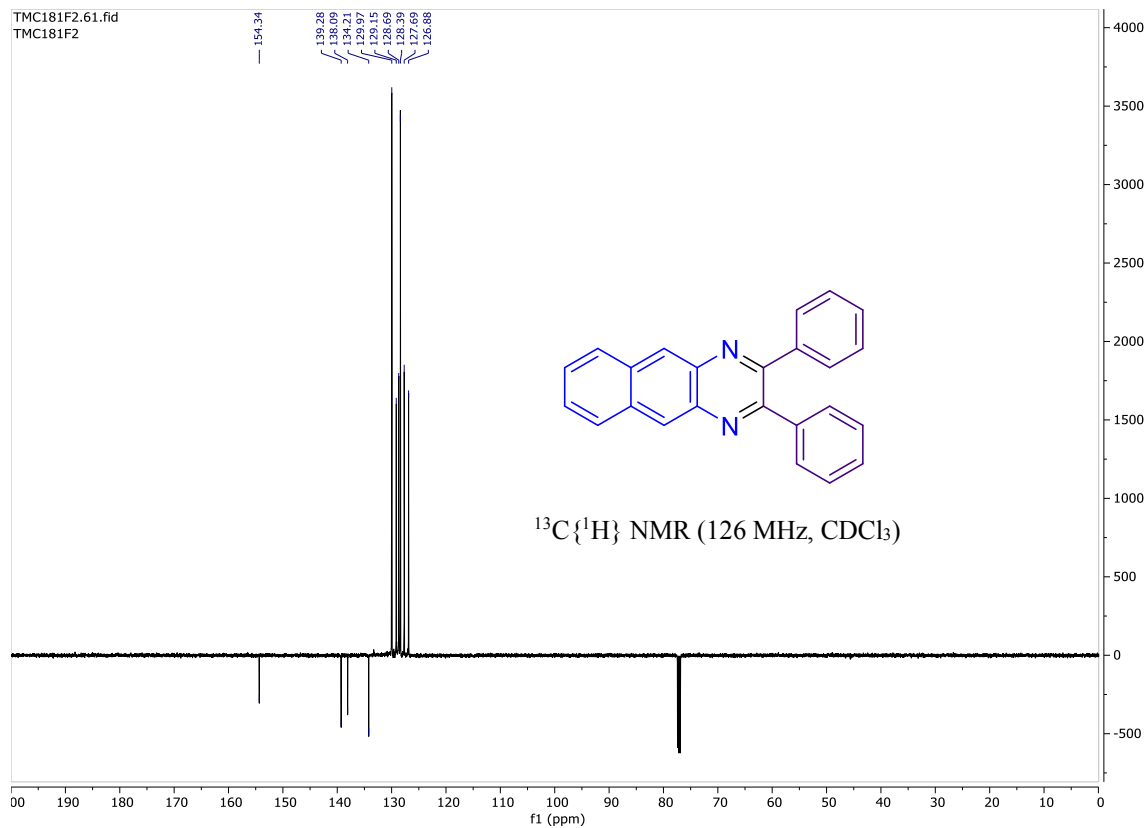
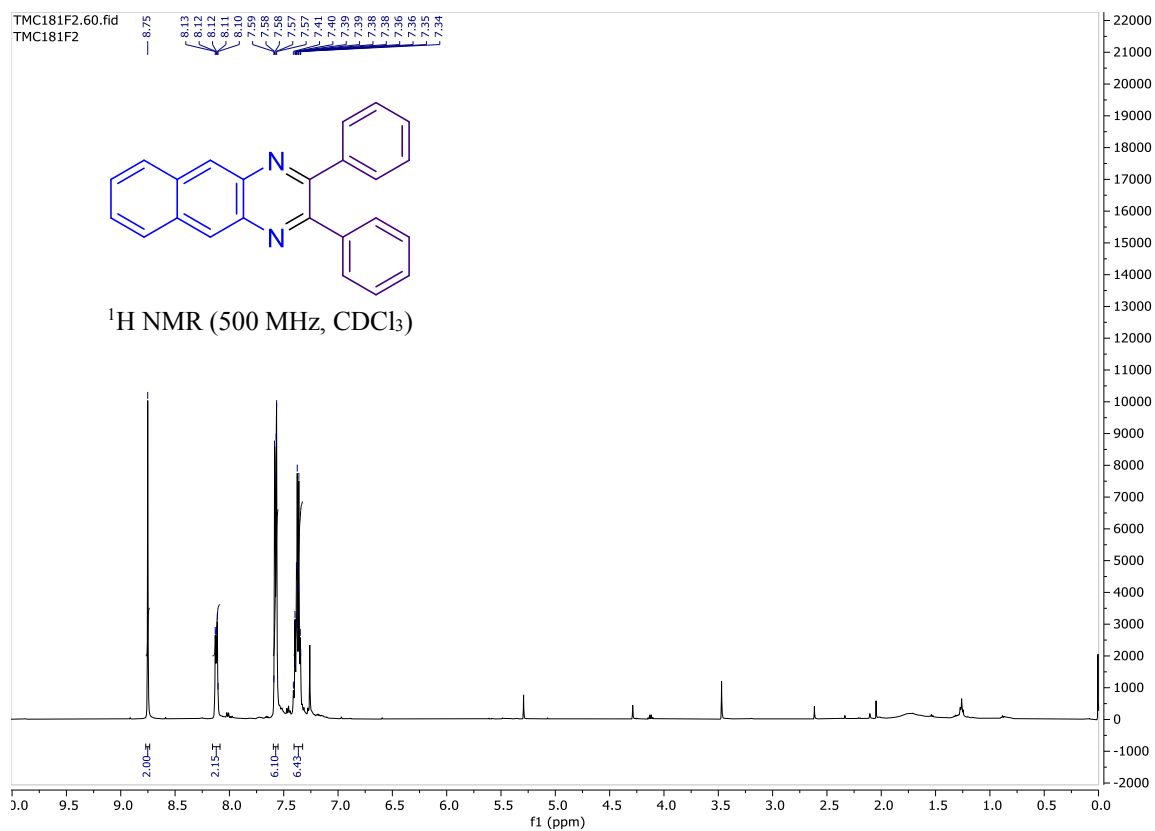
6-Nitro-2,3-diphenylquinoxaline (5ja)



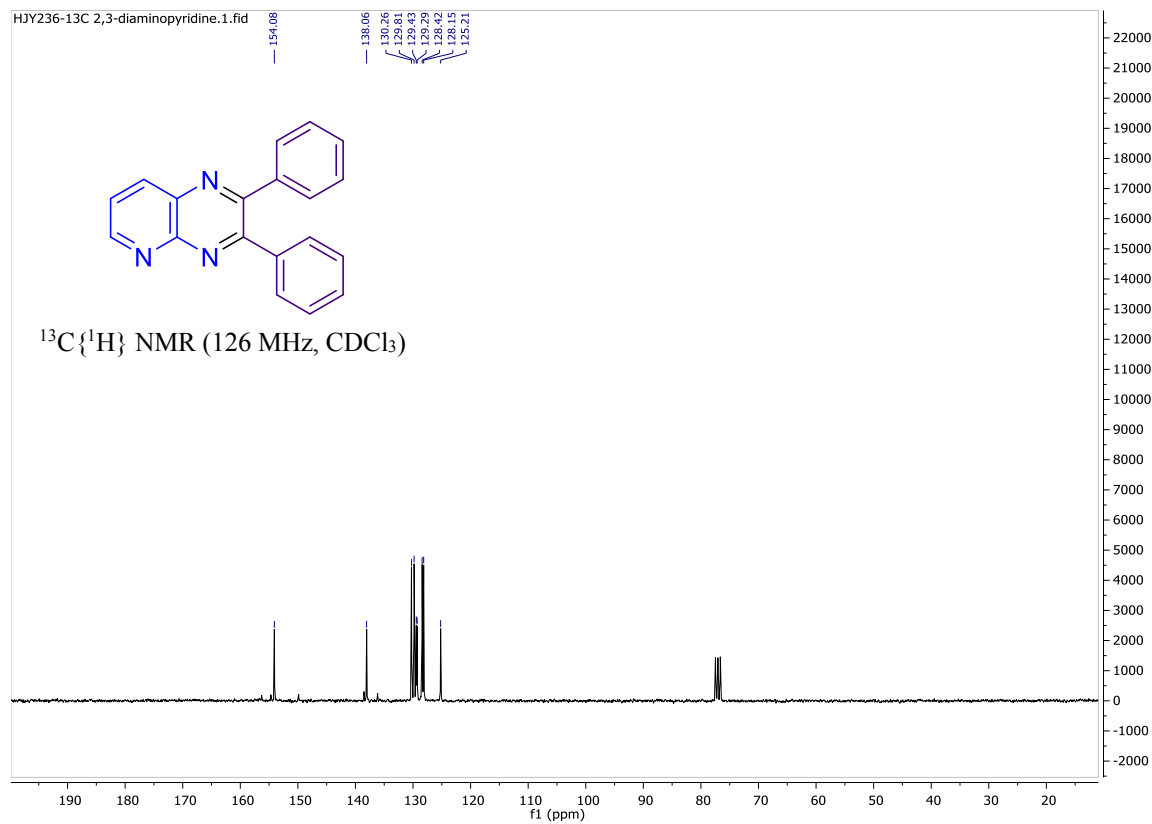
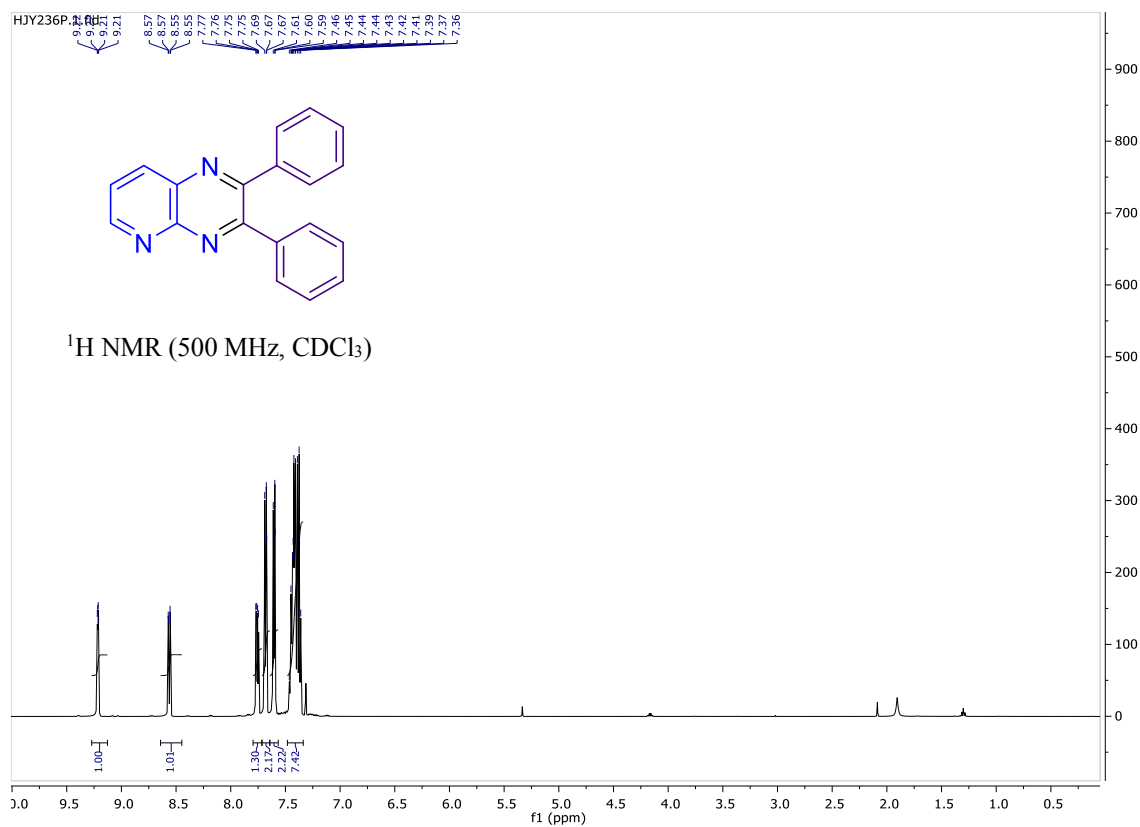
Ethyl 2,3-diphenylquinoxaline-6-carboxylate (5ka)



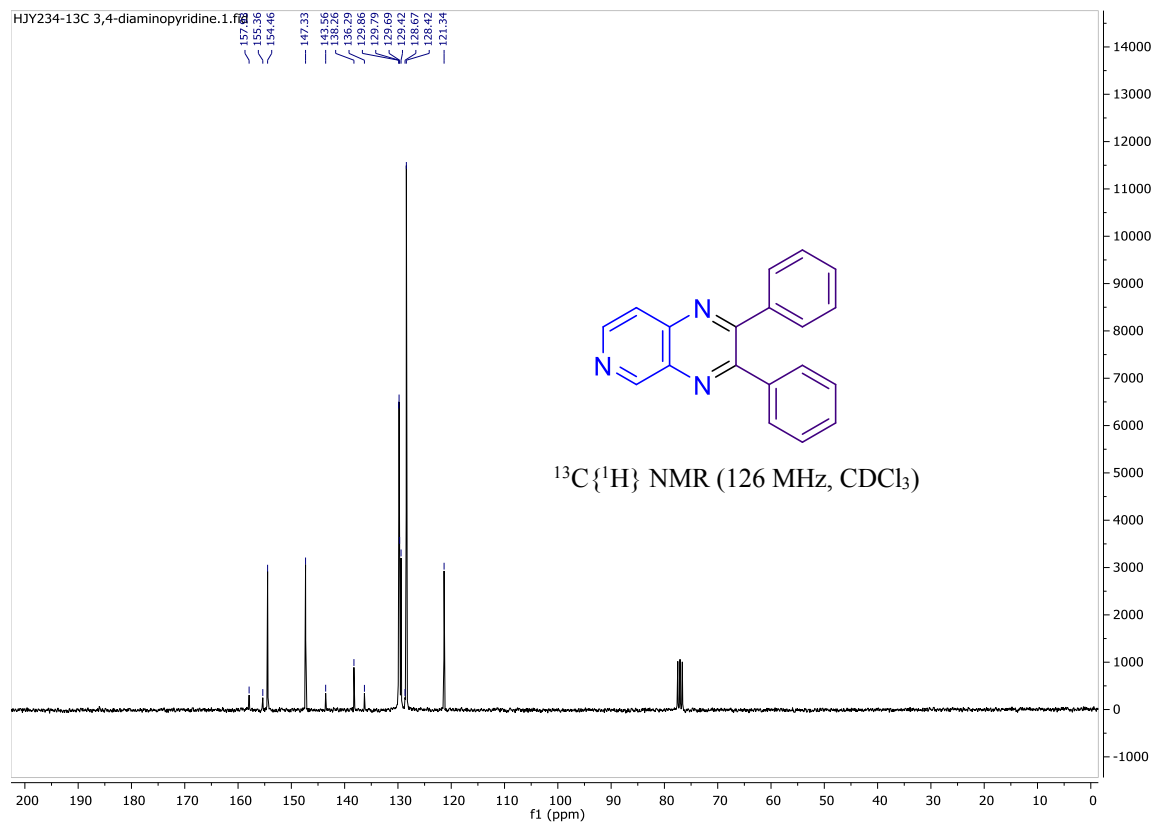
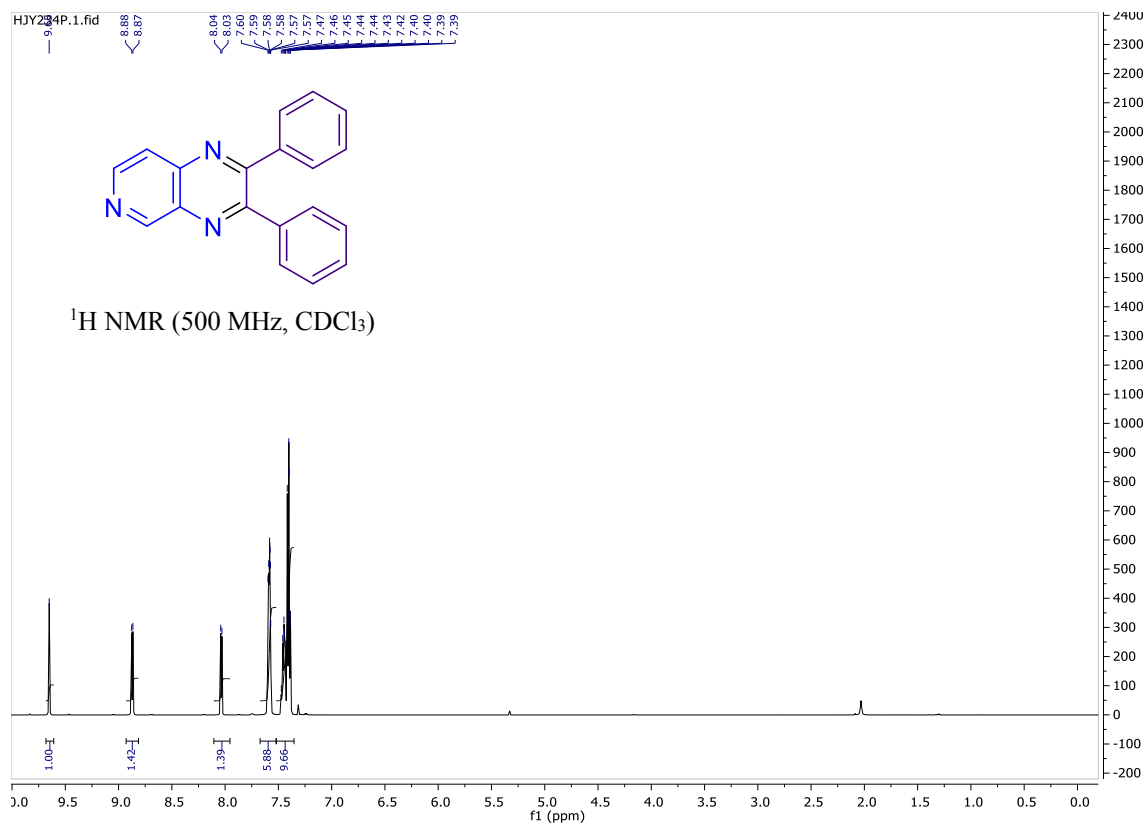
2,3-Diphenylbenzo[g]quinoxaline (51a)



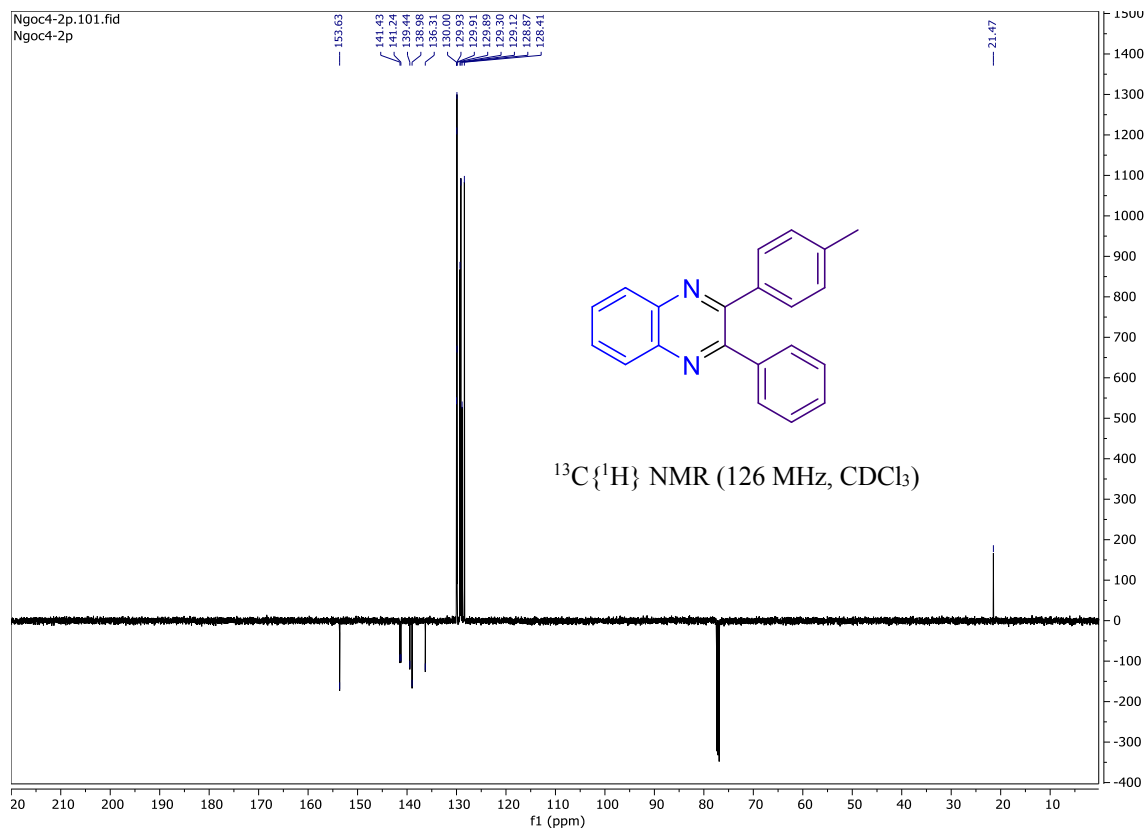
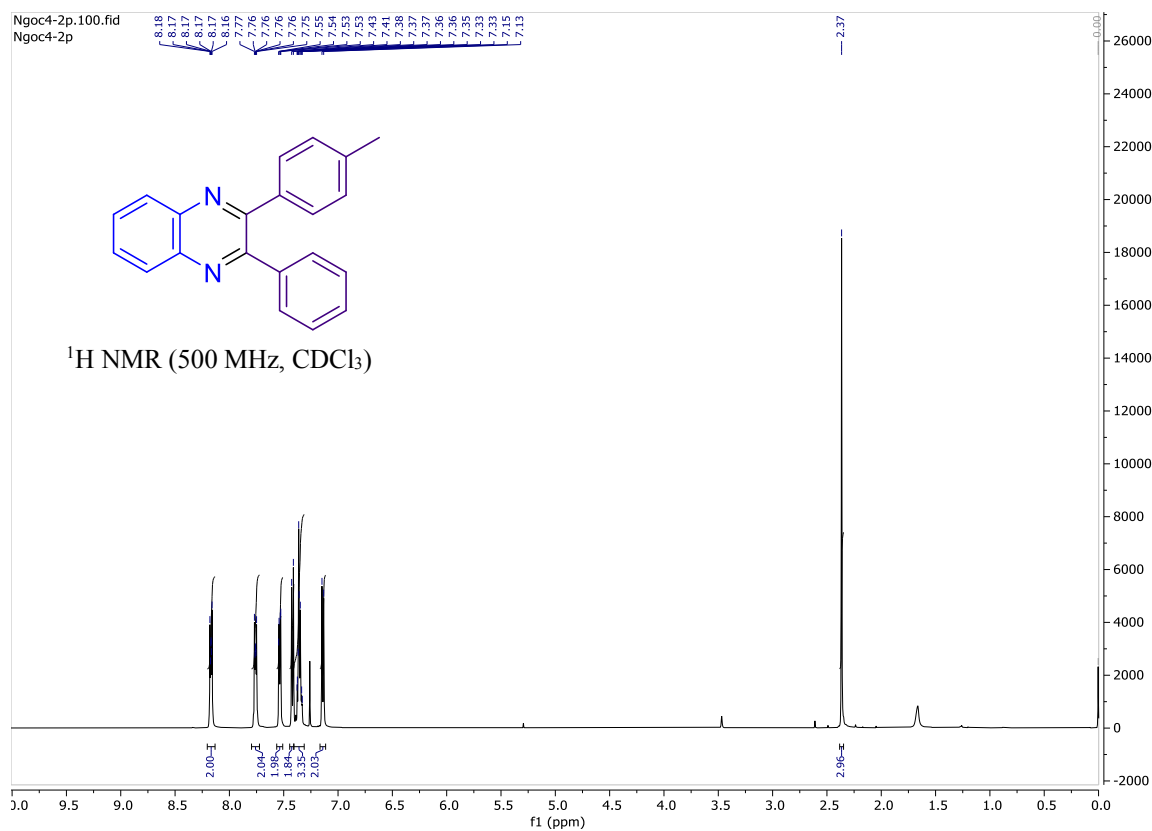
2,3-Diphenylpyrido[2,3-b]pyrazine (5ma)



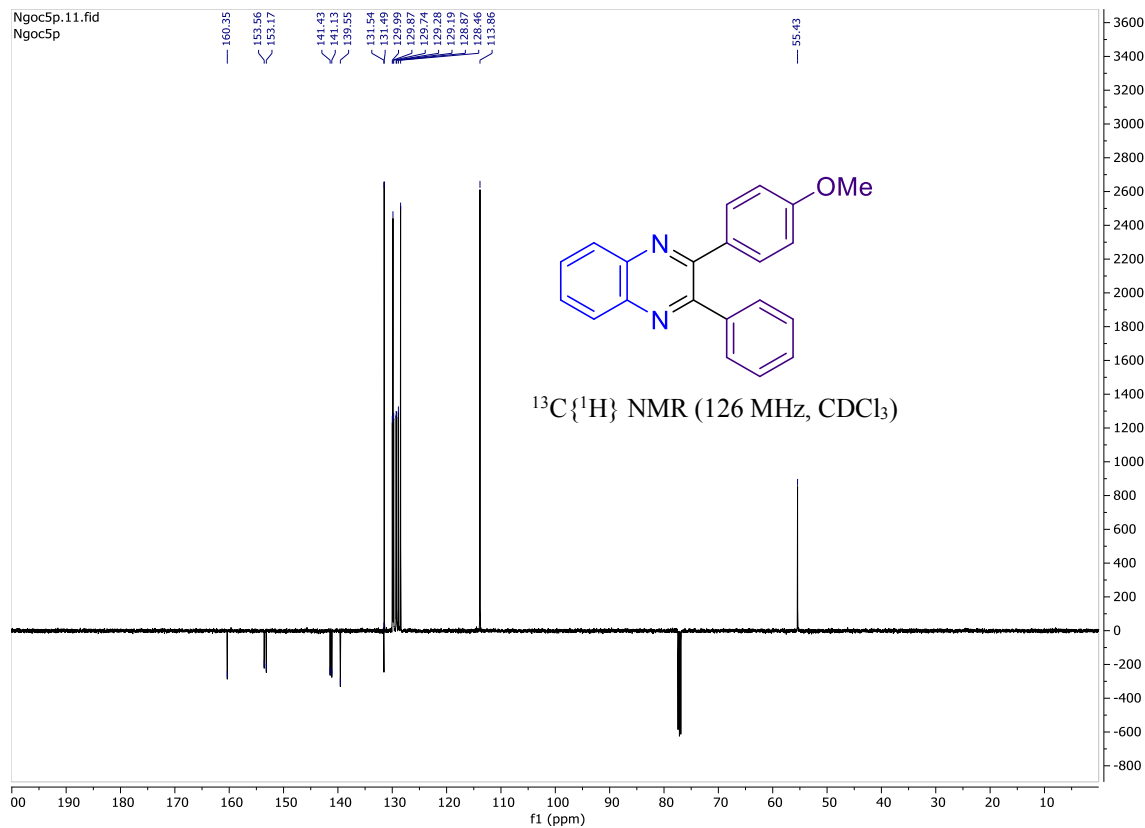
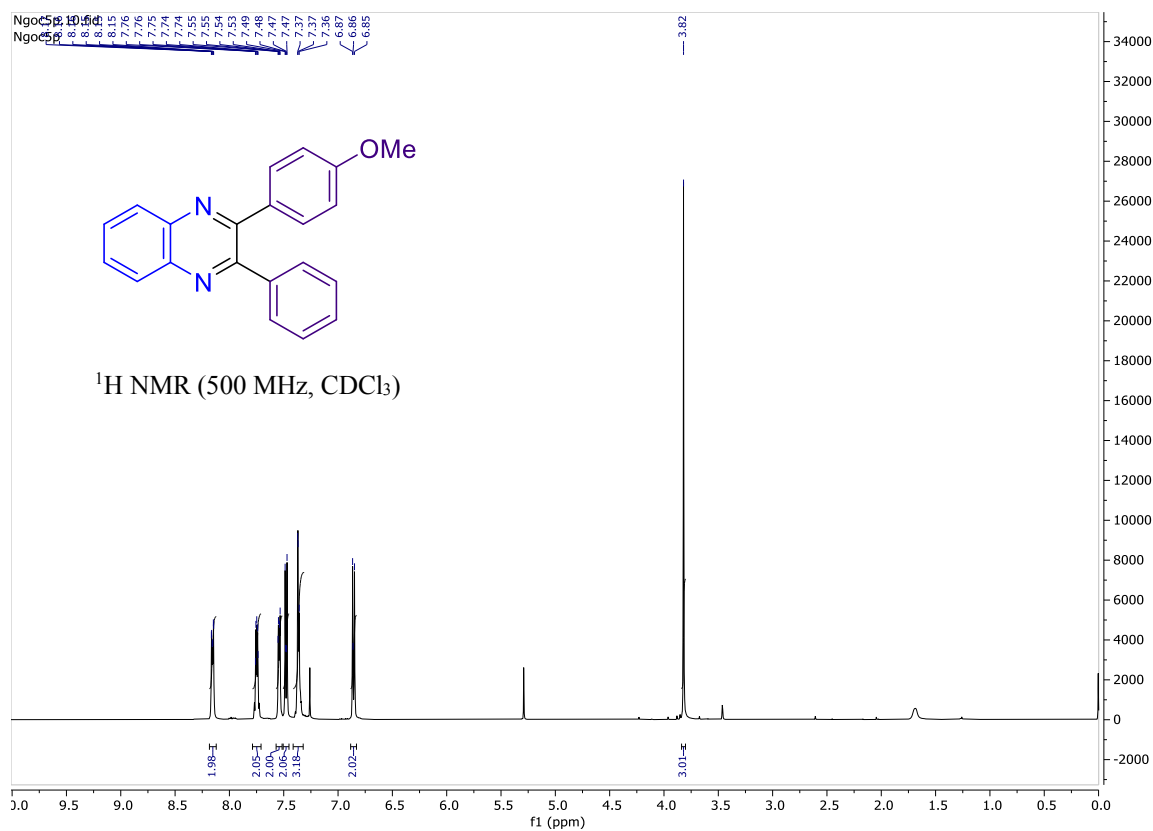
2,3-Diphenylpyrido[3,4-b]pyrazine (5na)



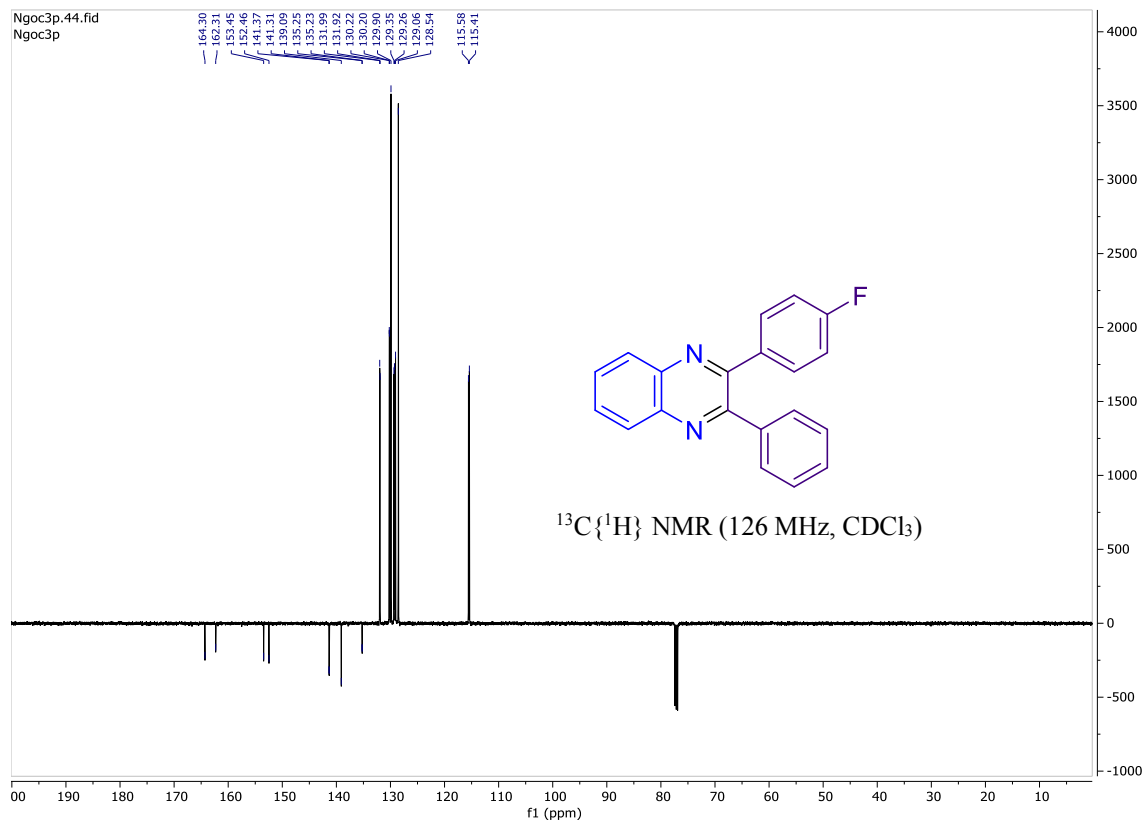
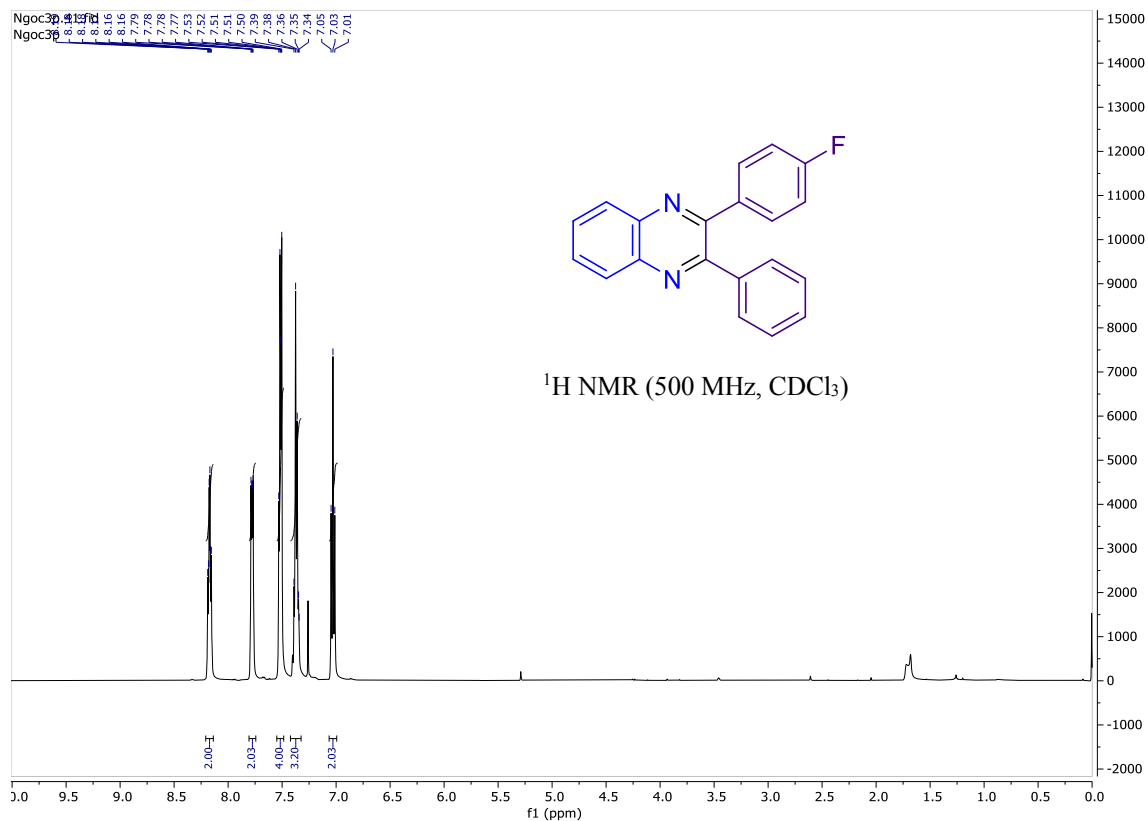
2-Phenyl-3-(p-tolyl)quinoxaline (5ab)



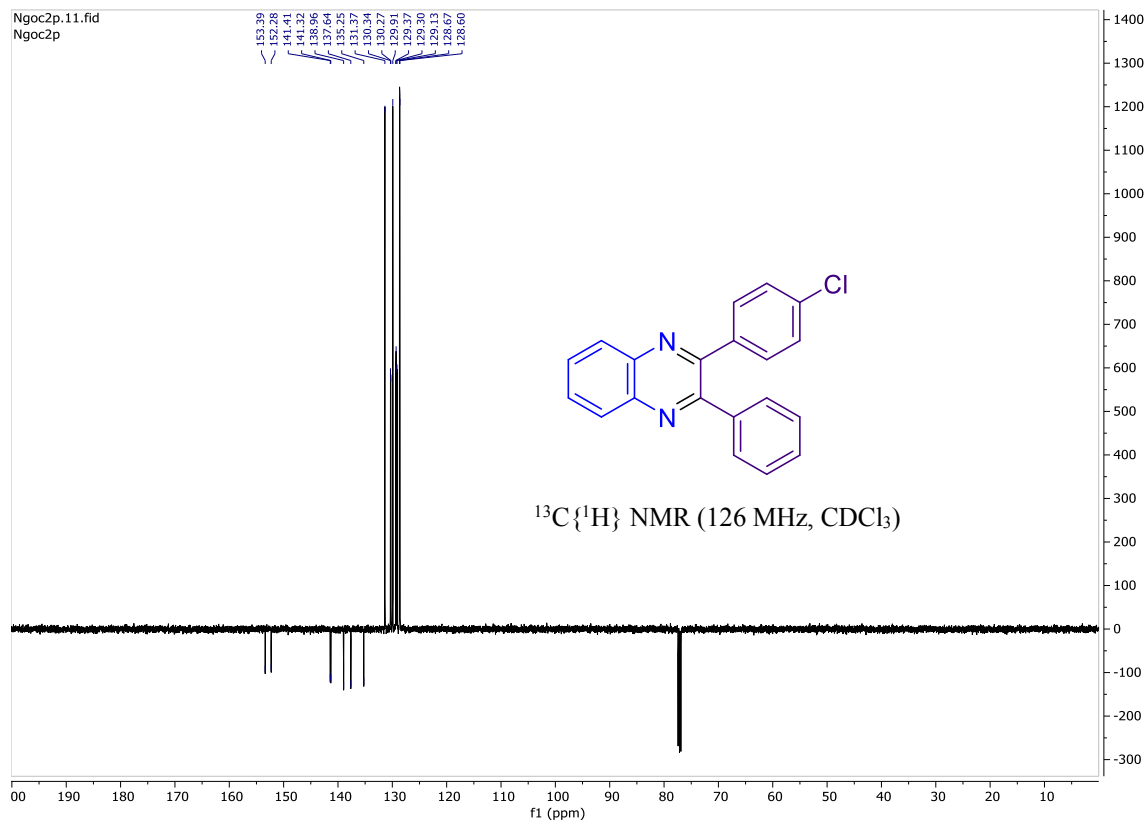
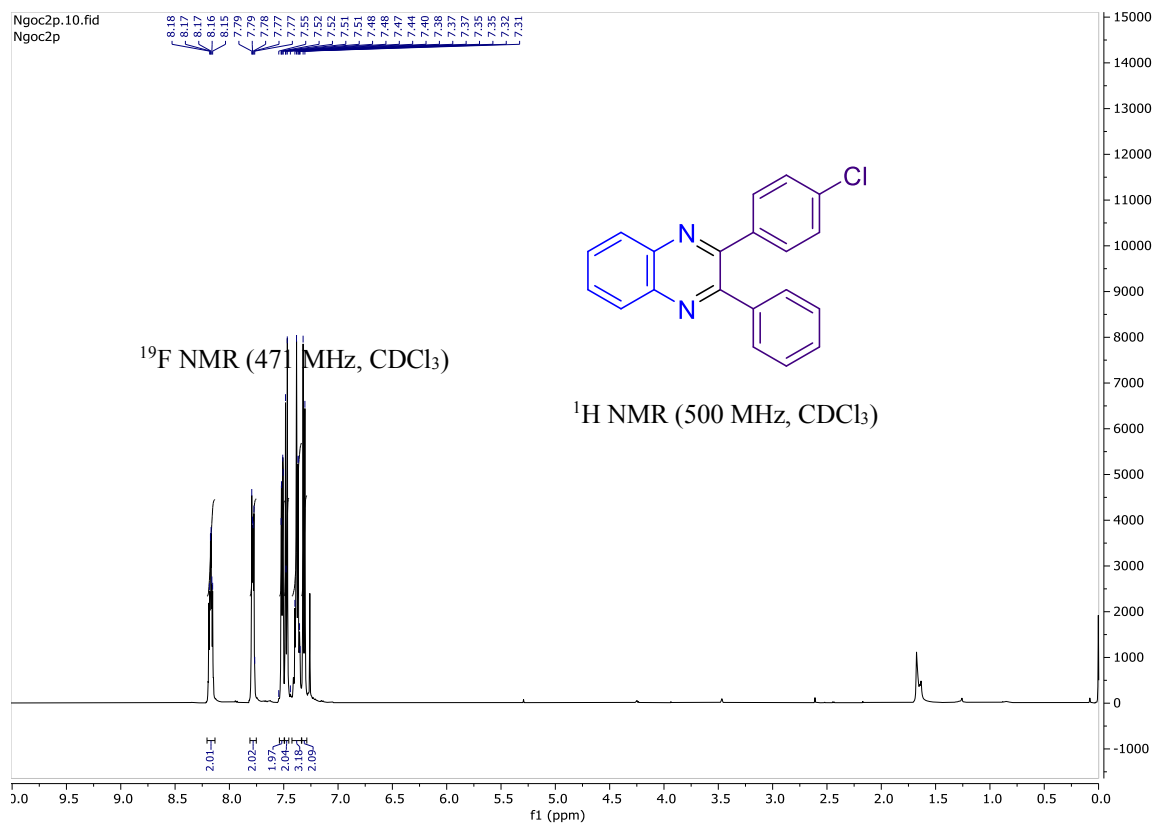
2-(4-Methoxyphenyl)-3-phenylquinoxaline (5ac)



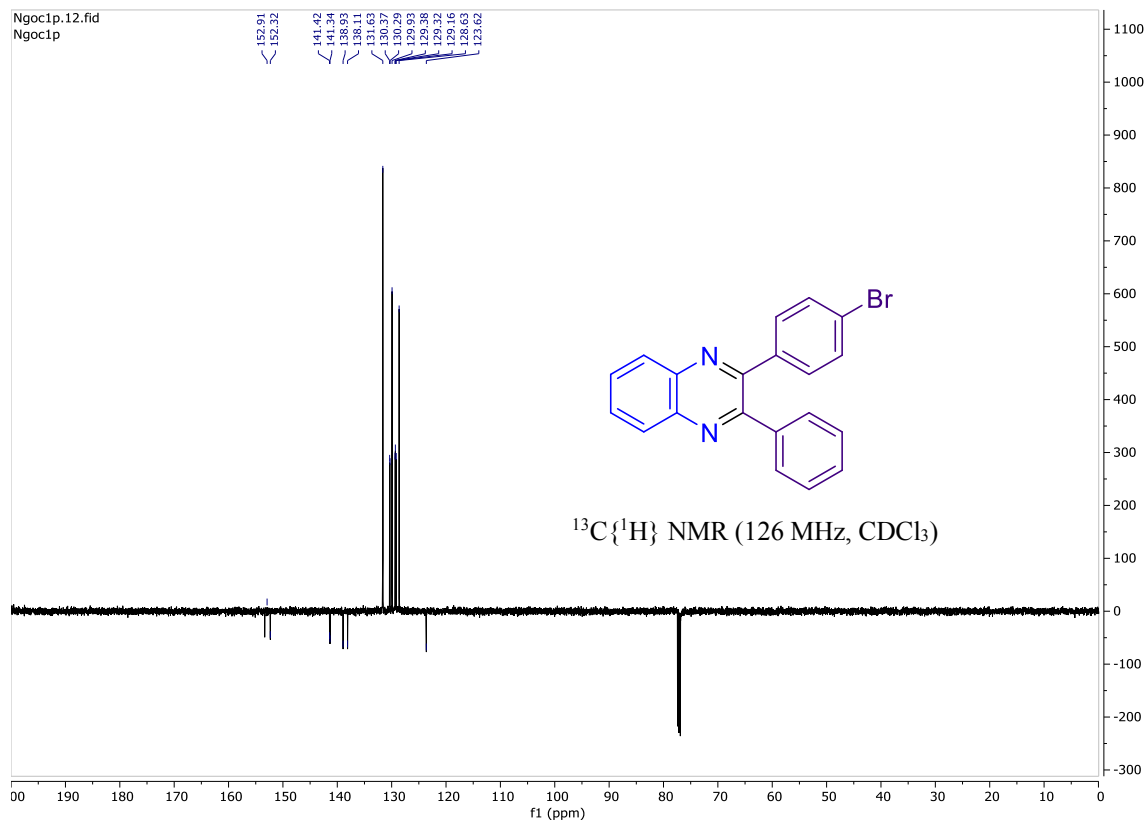
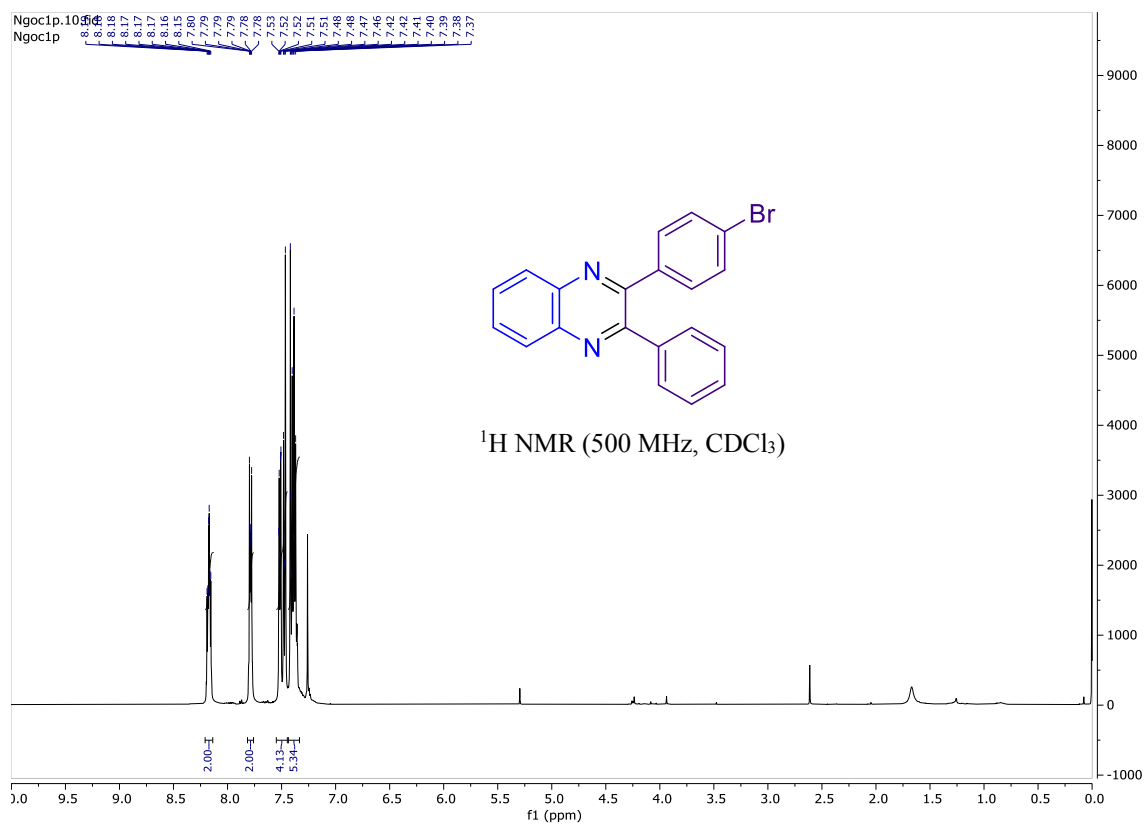
2-(4-Fluorophenyl)-3-phenylquinoxaline (5ad) (500 MHz, 126 MHz and 471 MHz, CDCl₃)



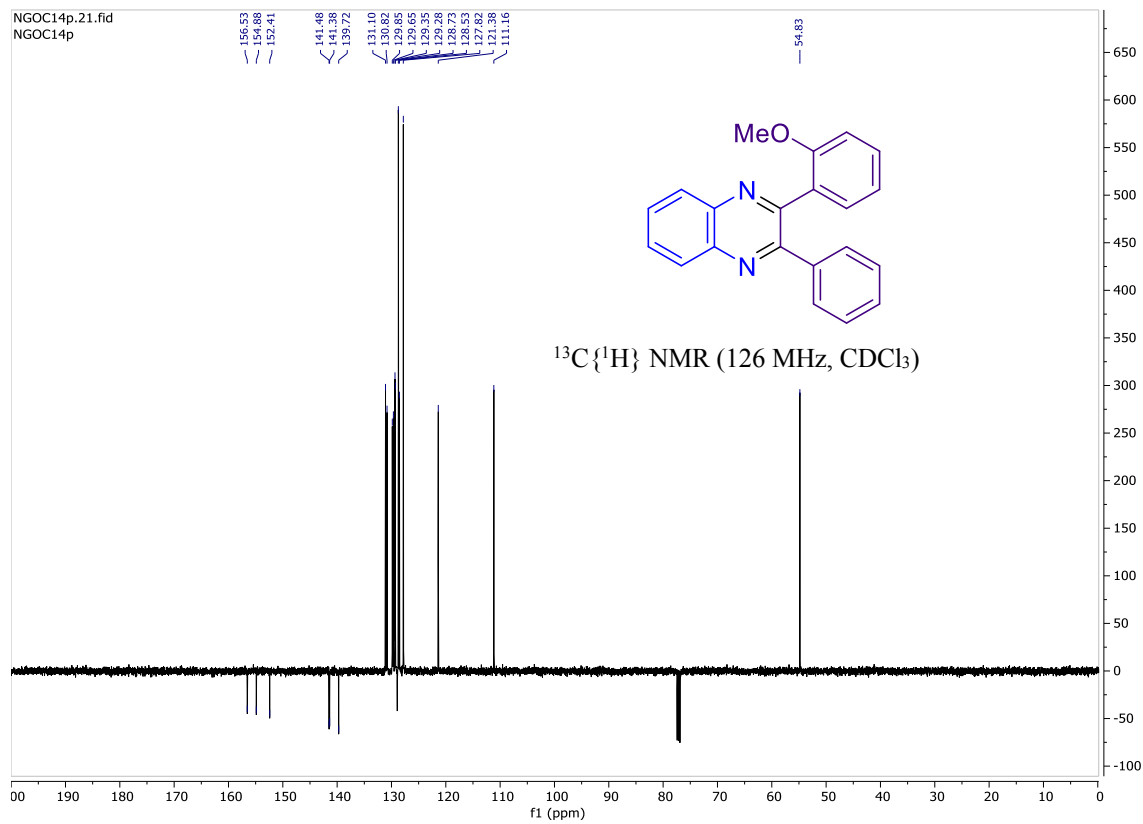
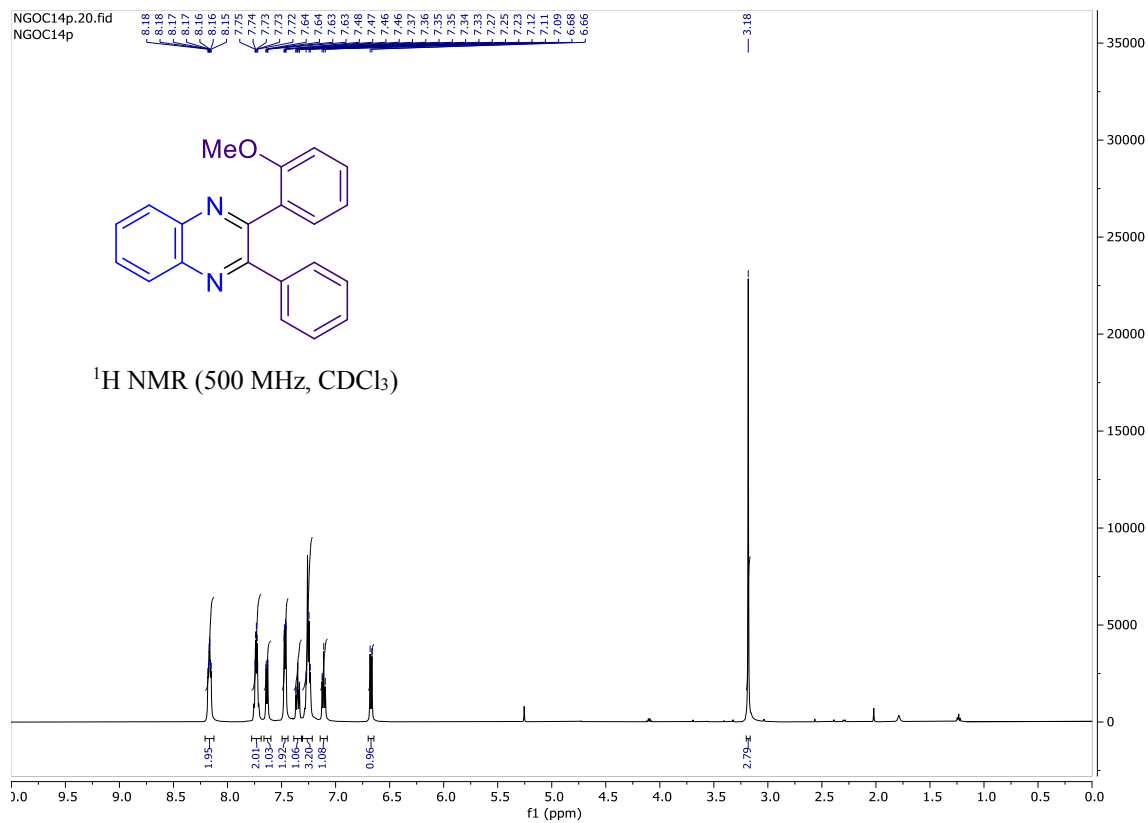
2-(4-Chlorophenyl)-3-phenylquinoxaline (5ae)



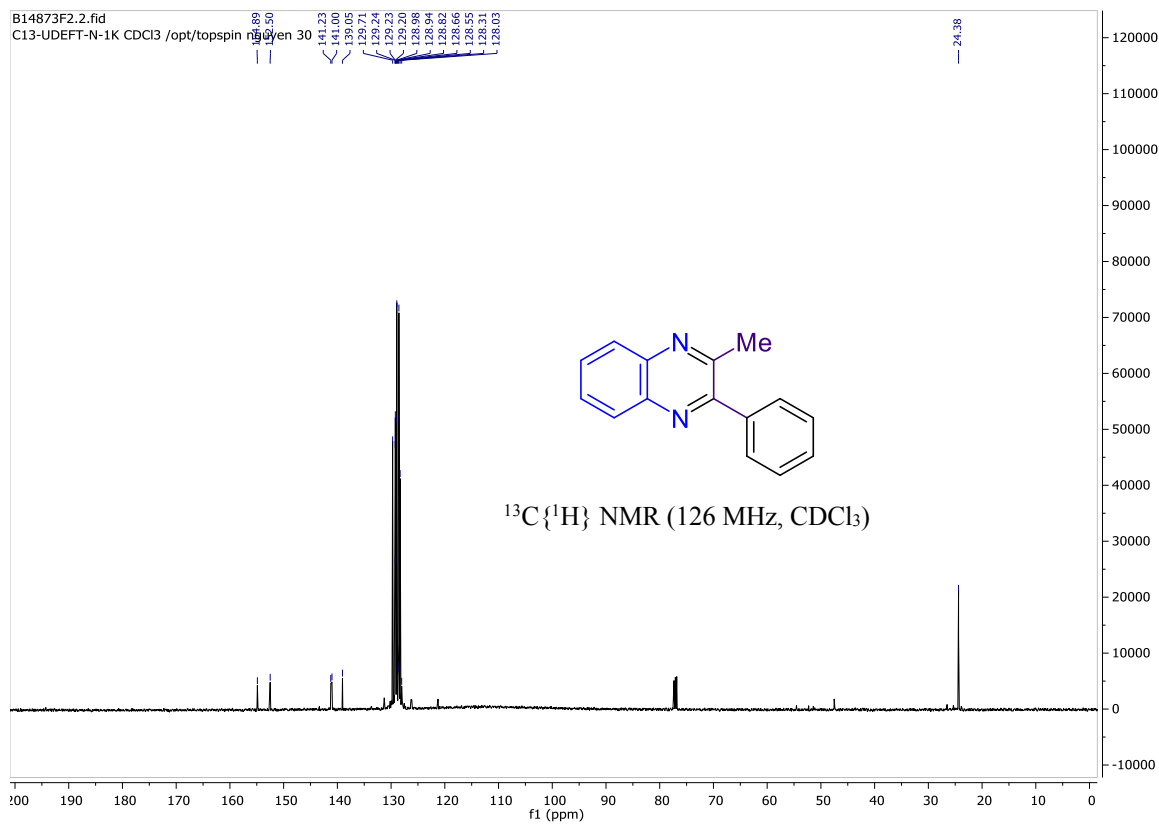
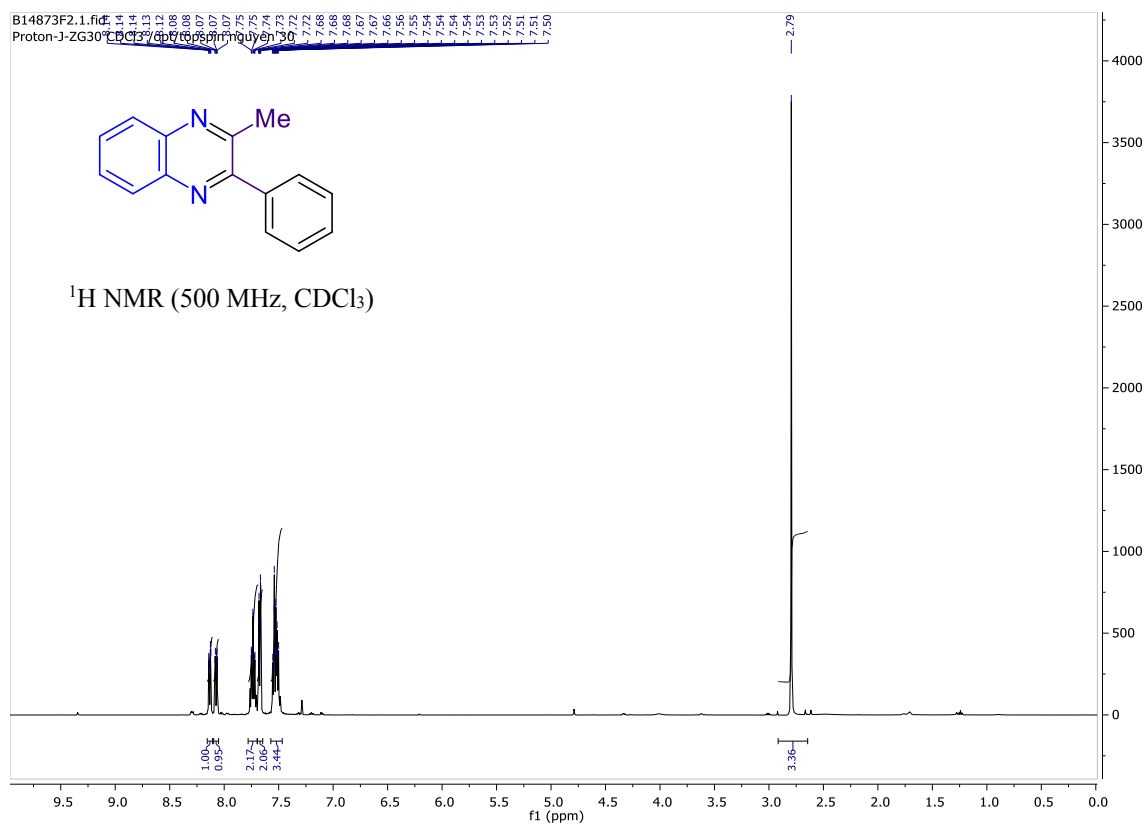
2-(4-Bromophenyl)-3-phenylquinoxaline (5af)



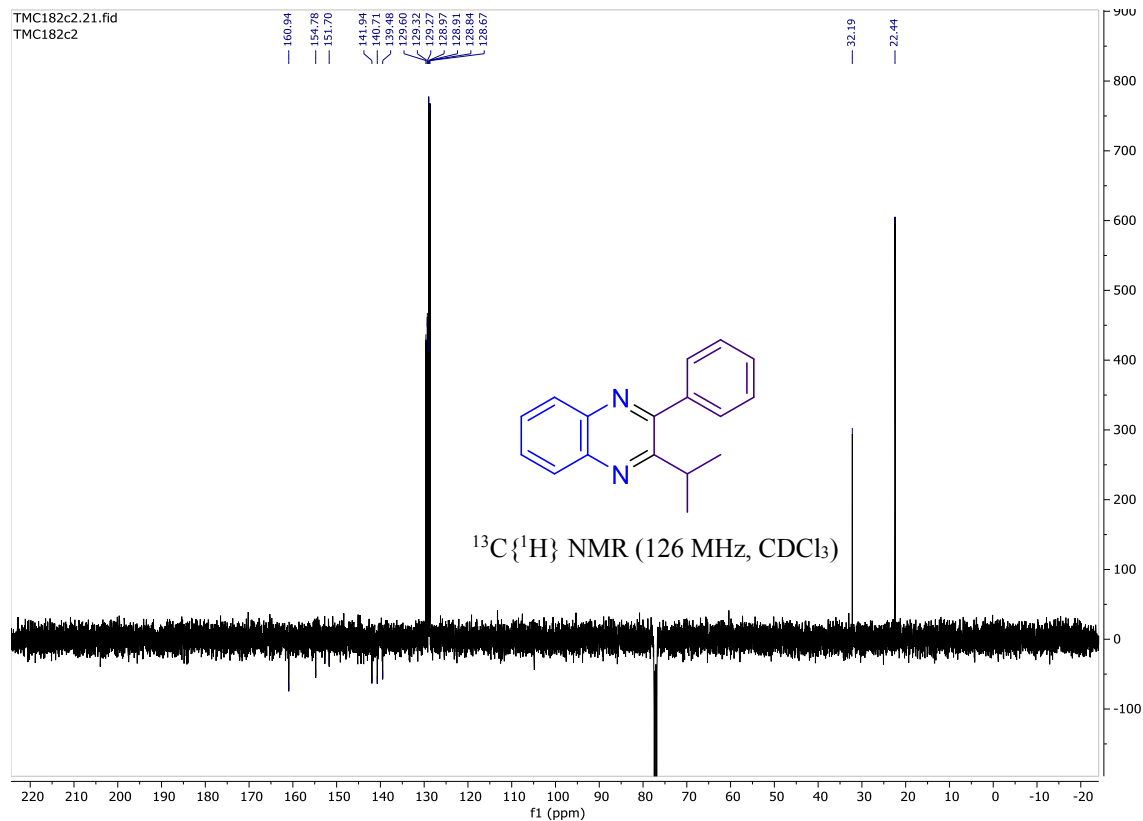
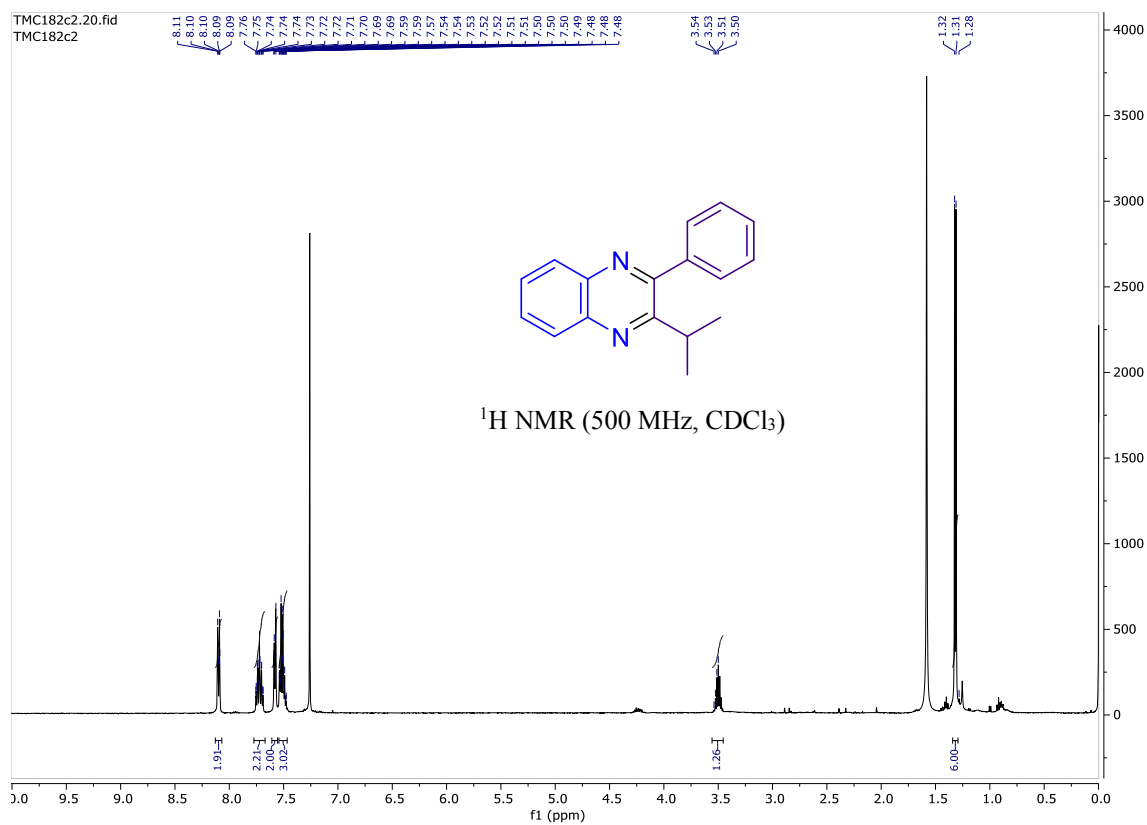
2-(2-Methoxyphenyl)-3-phenylquinoxaline (5ag)



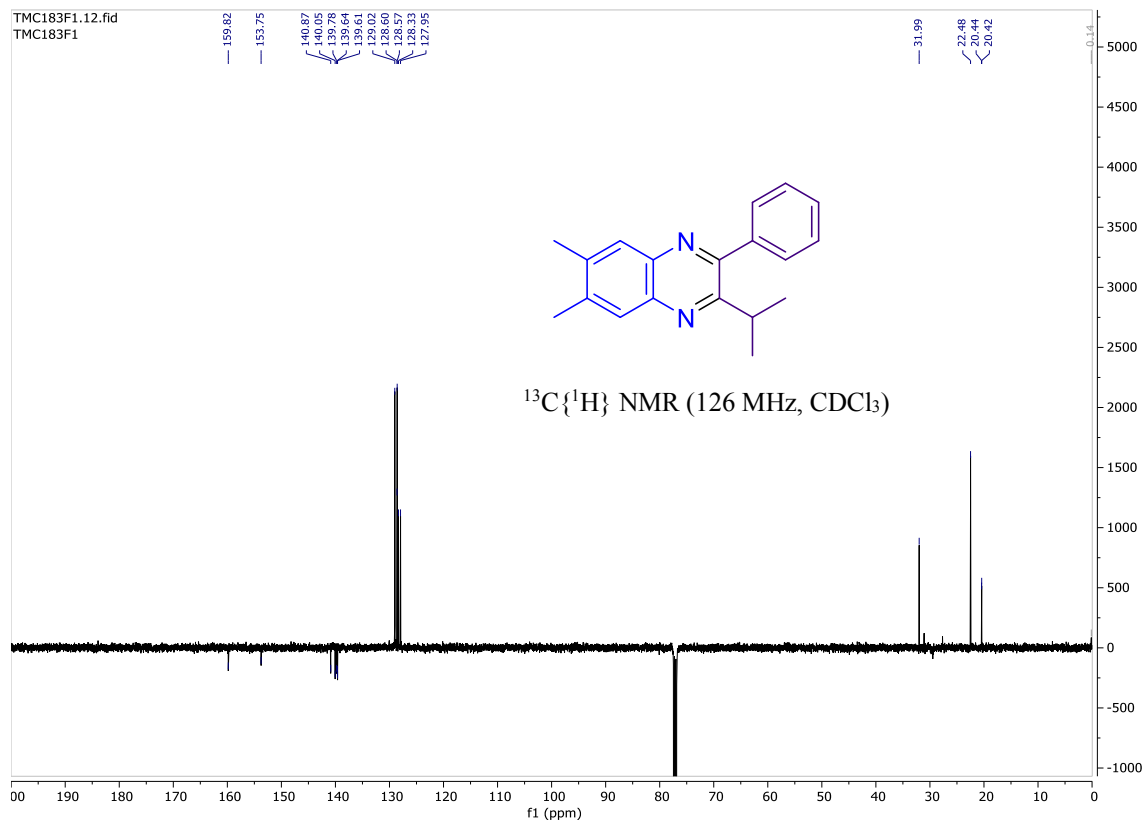
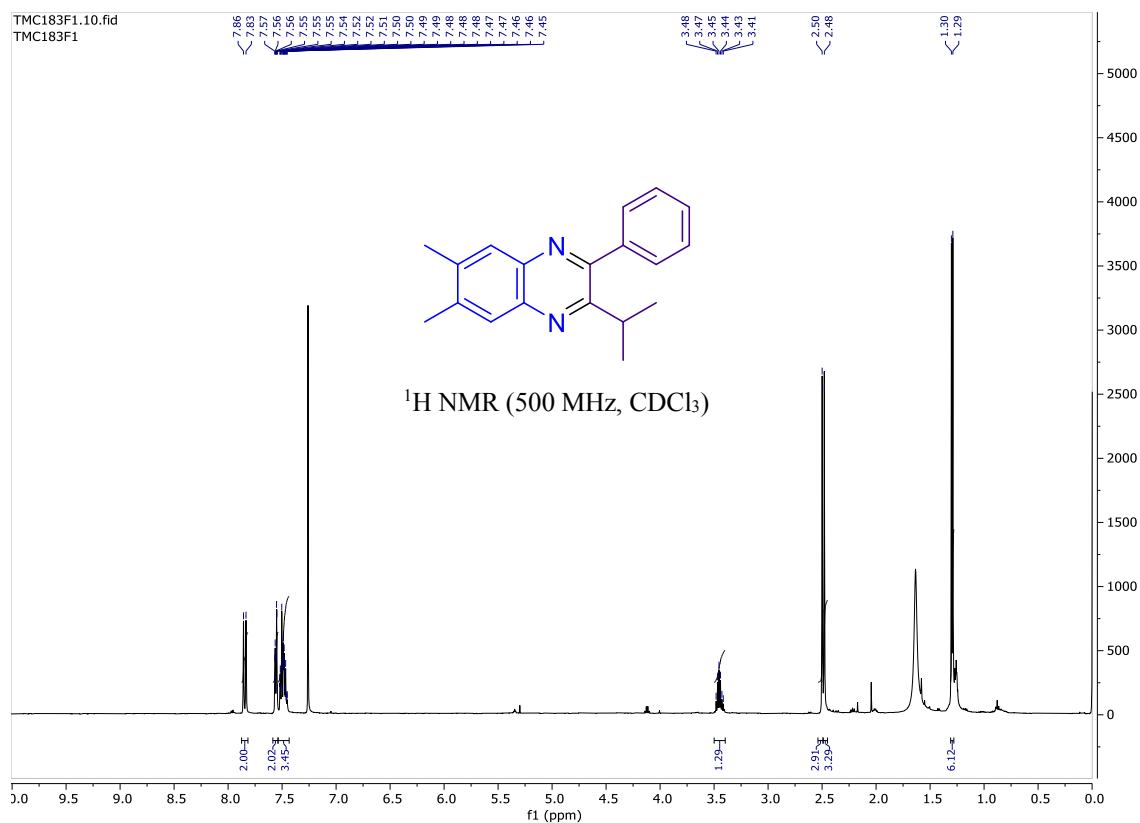
2-Methyl-3-phenylquinoxaline (5ah)



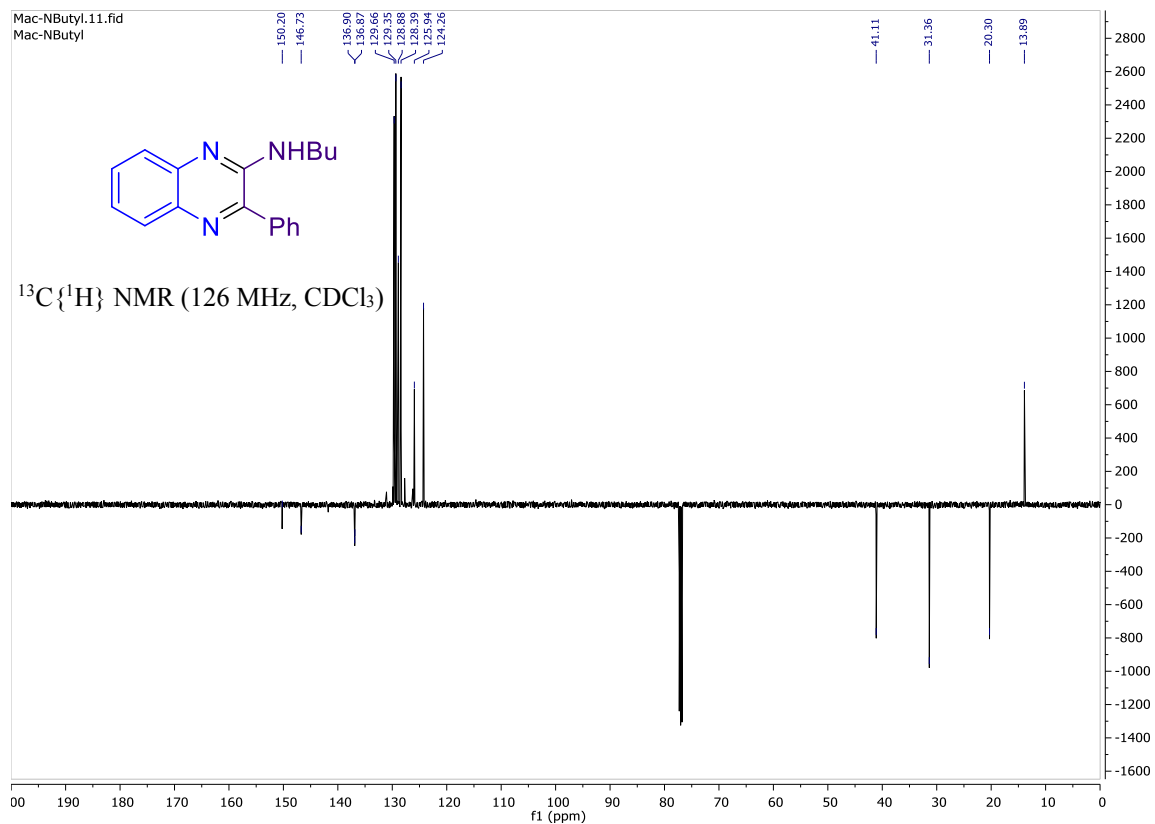
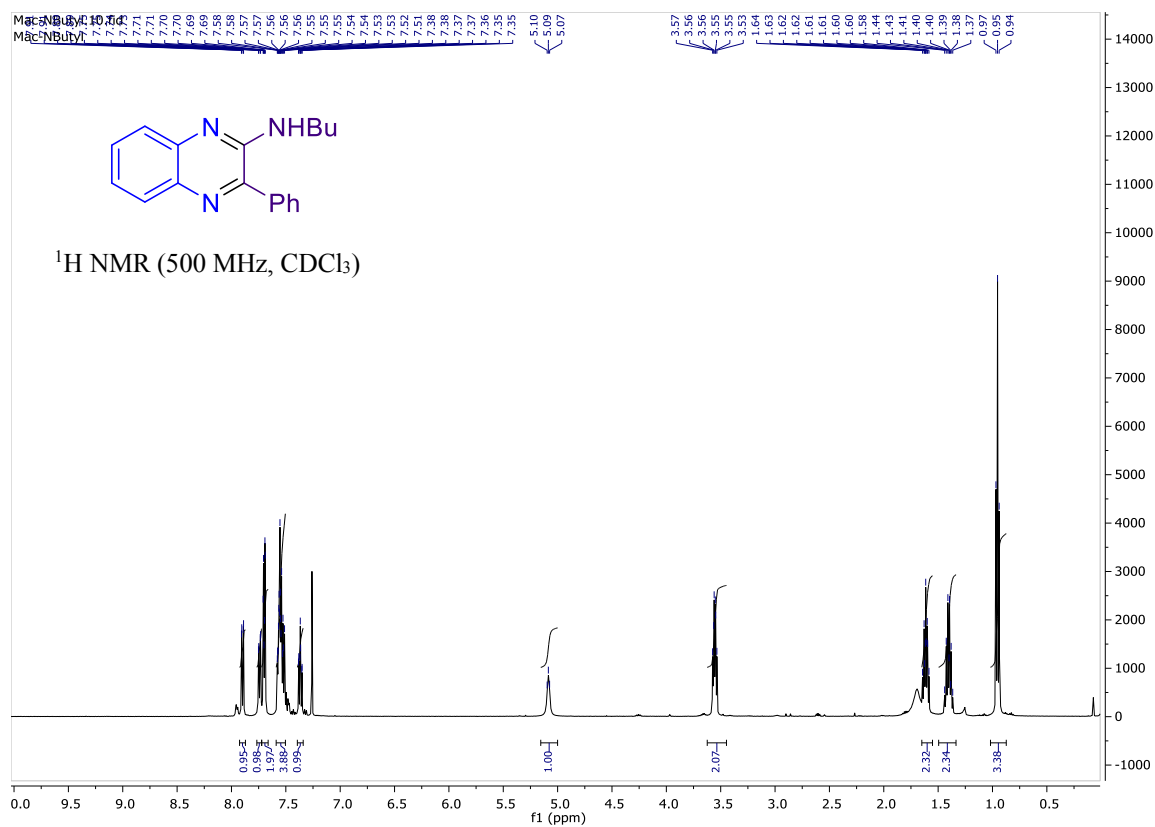
2-Isopropyl-3-phenylquinoxaline (5ai)



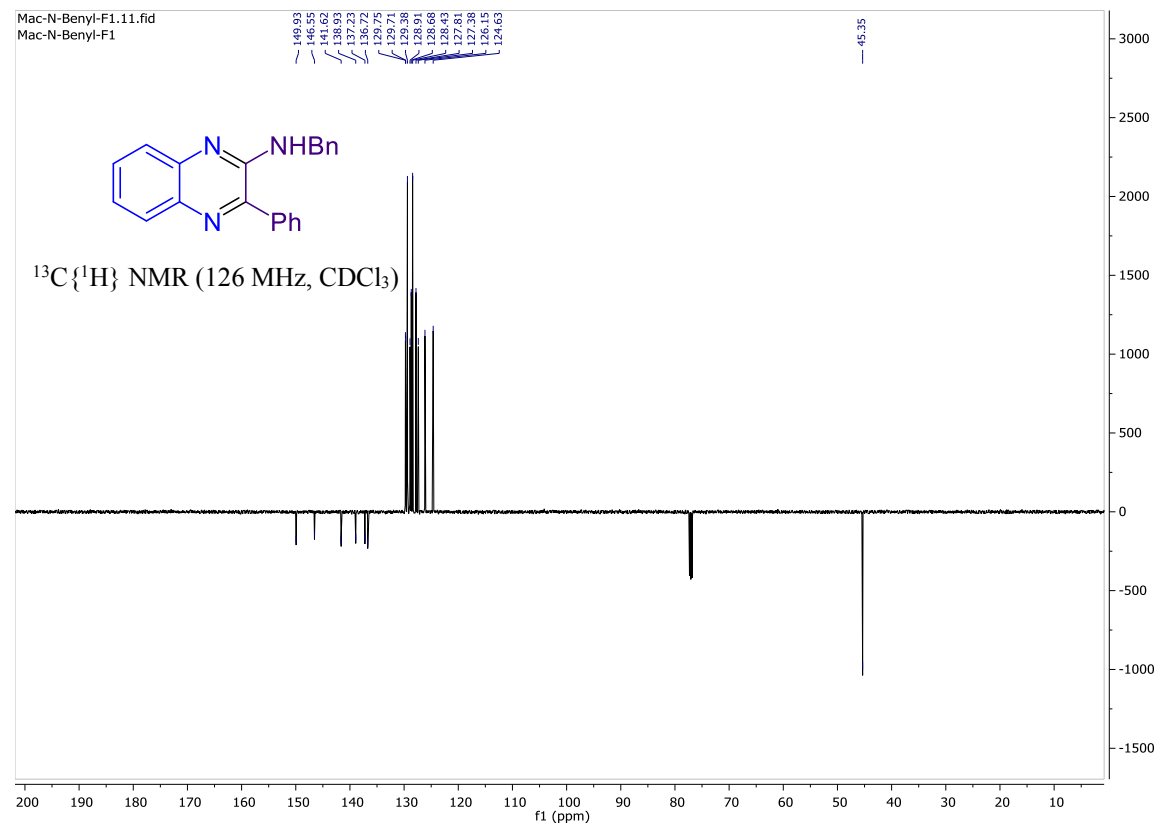
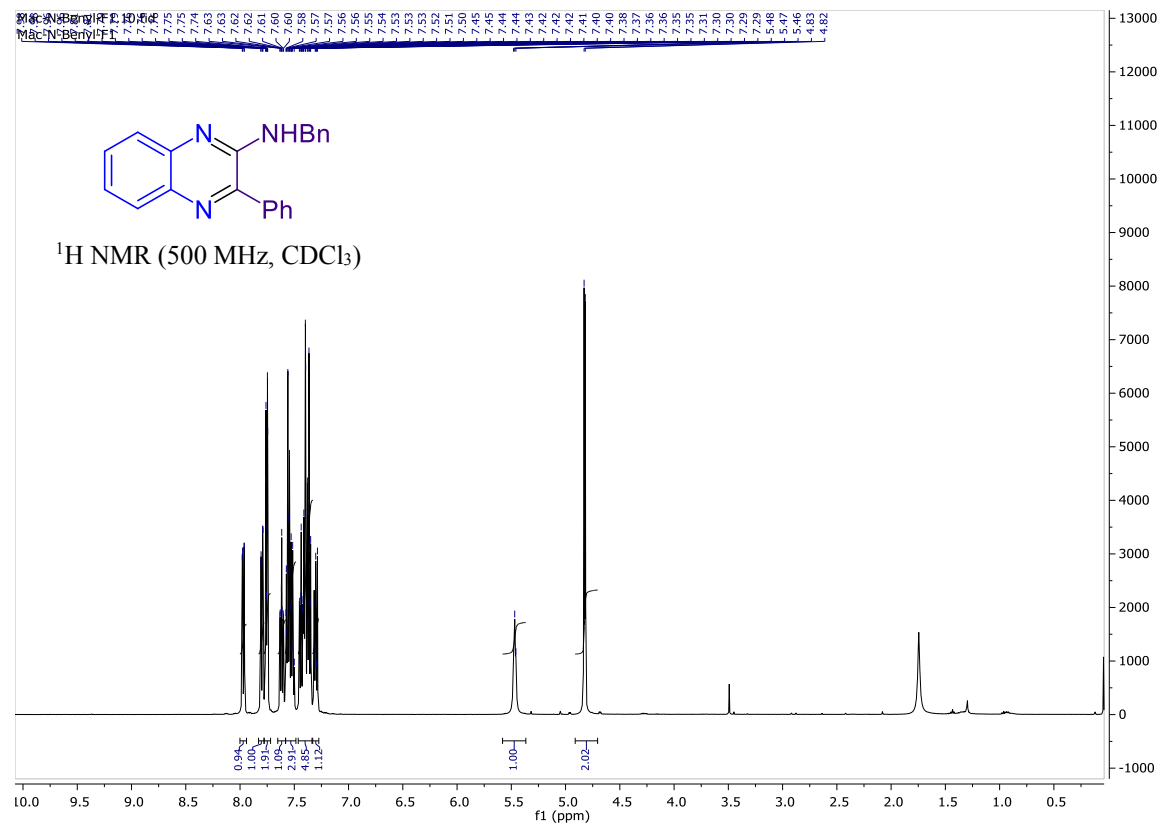
2-Isopropyl-6,7-dimethyl-3-phenylquinoxaline (5bi)



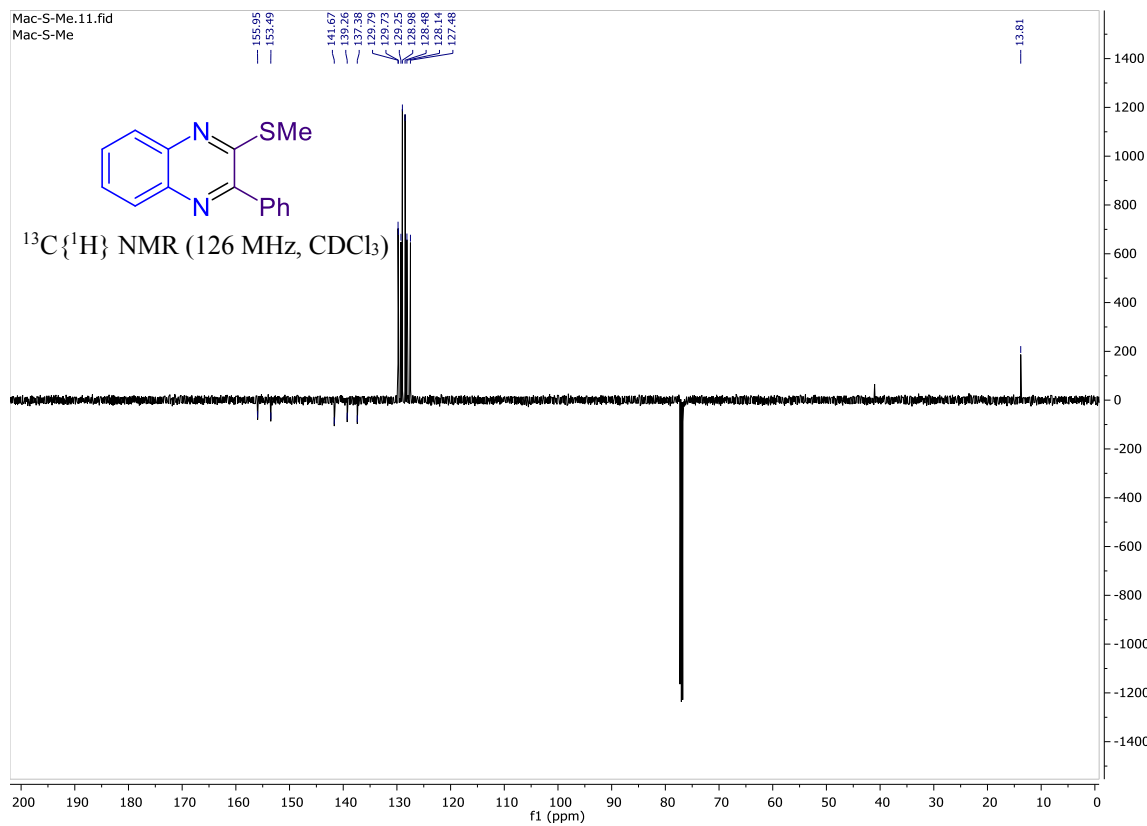
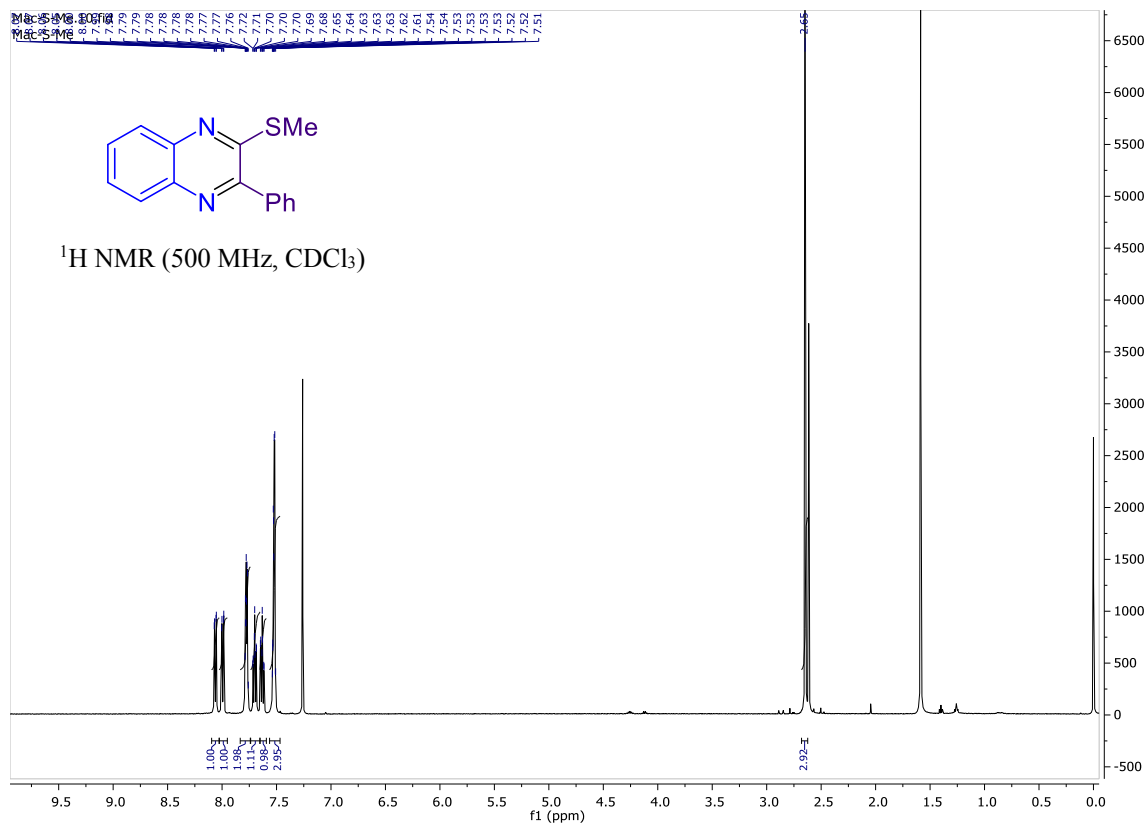
N-Butyl-3-phenylquinoxalin-2-amine (6a)



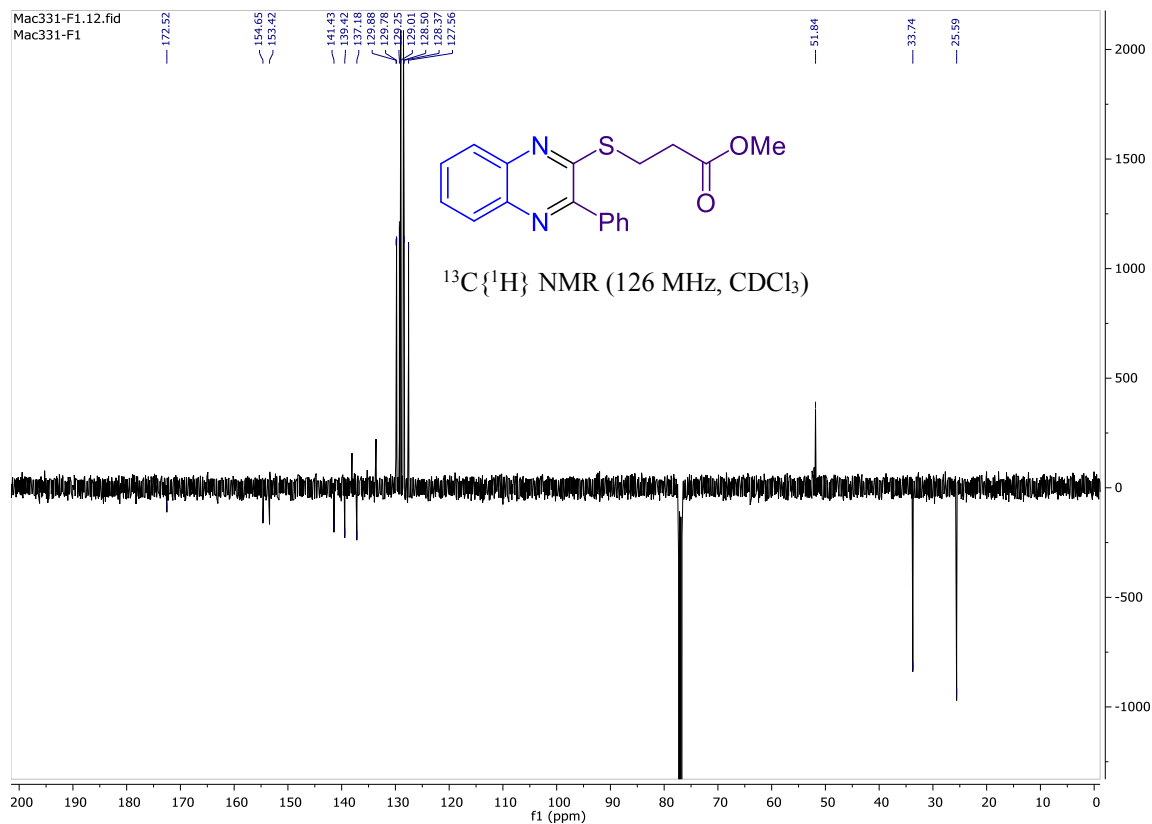
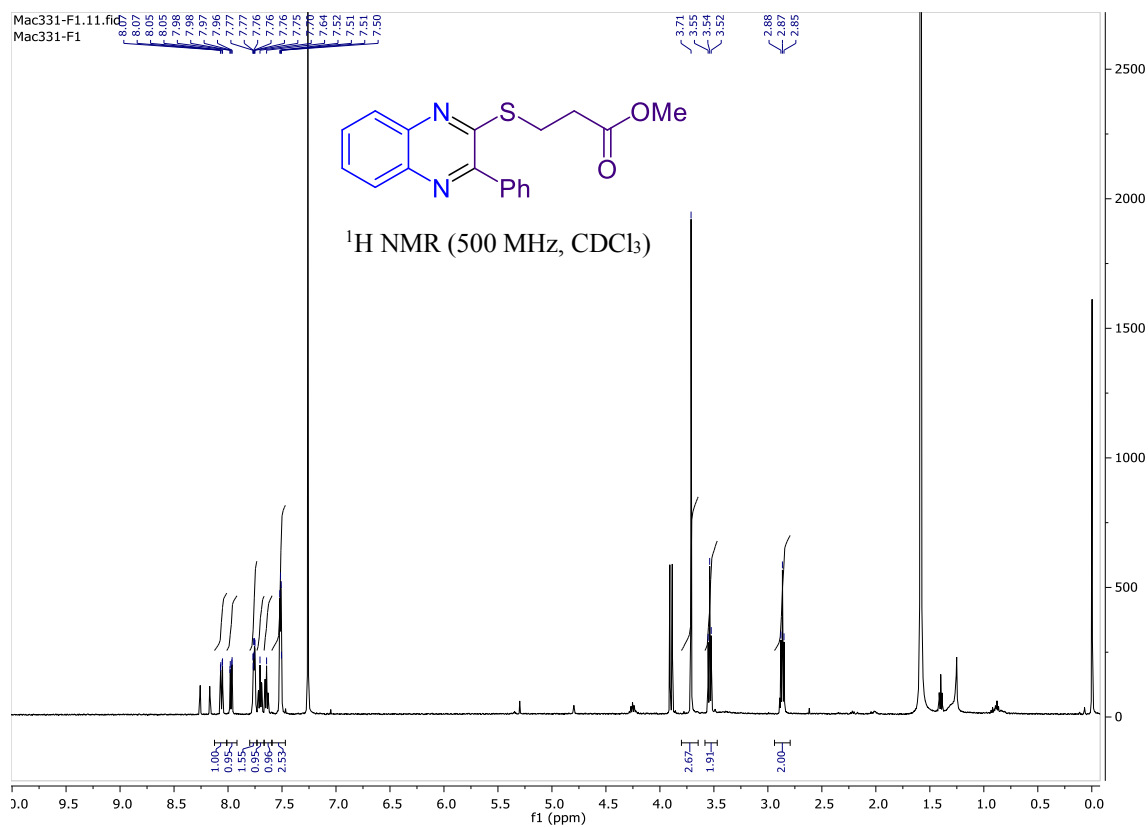
N-Benzyl-3-phenylquinoxalin-2-amine (6b)



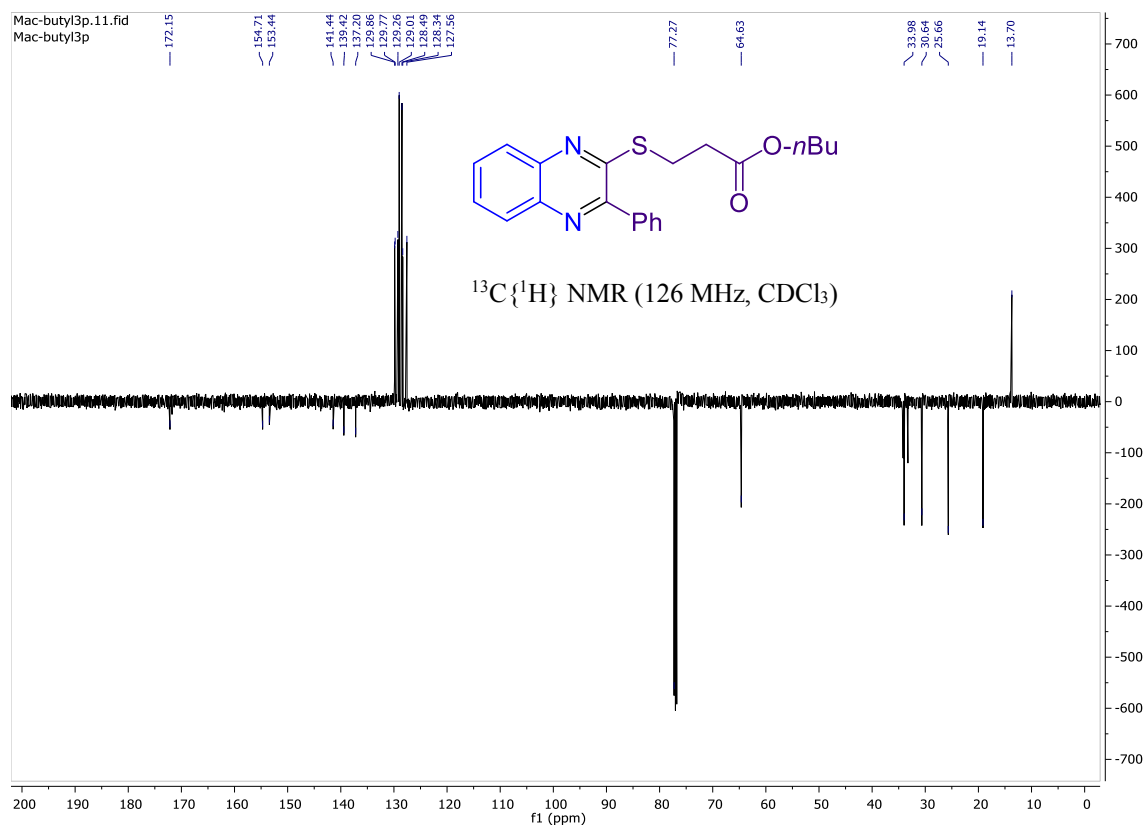
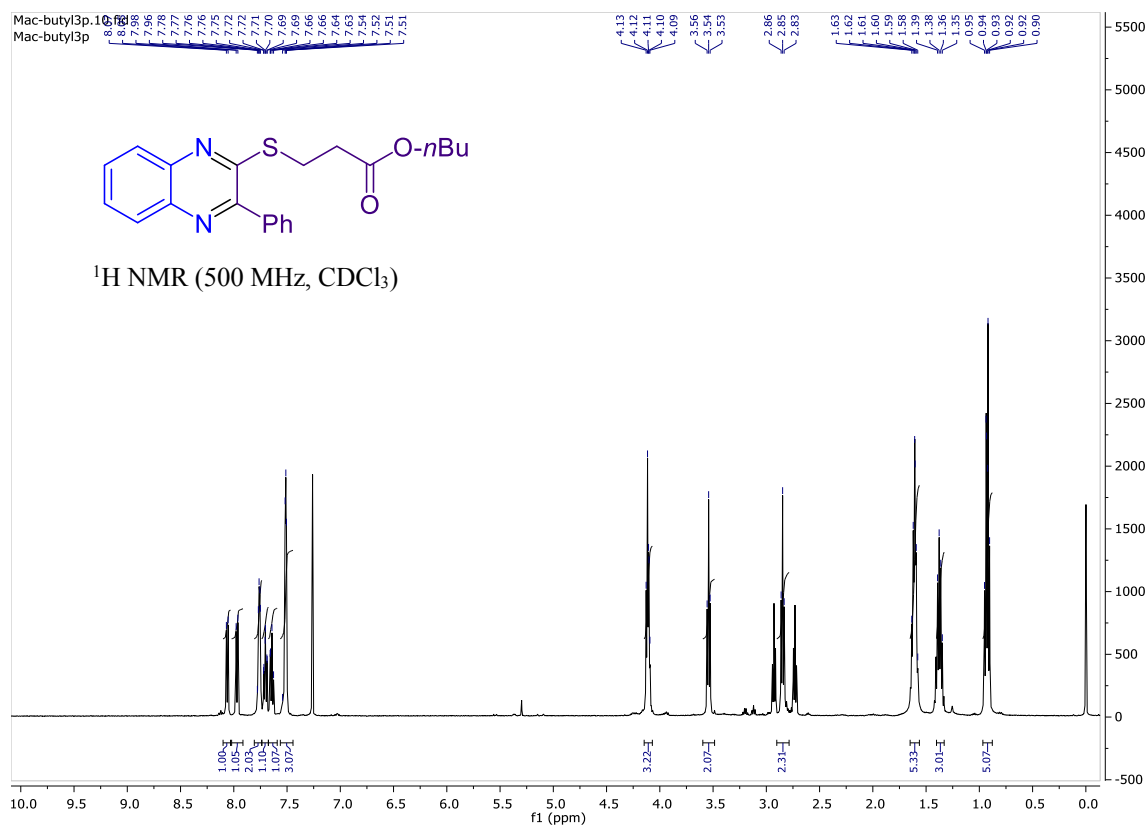
2-(Methylthio)-3-phenylquinoxaline (7)



Methyl 3-((3-phenylquinoxalin-2-yl)thio)propanoate (8a)



Butyl 3-((3-phenylquinoxalin-2-yl)thio)propanoate (8b)



3-((3-Phenylquinoxalin-2-yl)thio)propanenitrile (8c)

