

Electronic Supplementary Information:

**Self condensation of enamines mediated by acetylation. Novel approach to 1-(azol-5-yl)-
(1E,3Z)-butadiene-4-N,N-dimethylamines.**

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Experimental section

General aspects

^1H and ^{13}C NMR spectra were recorded on Bruker Avance II spectrometer in DMSO- d_6 (400 and 100 MHz, respectively) using Me_4Si as an internal standard.

The mass analyzer was a Bruker Daltonics MicrOTOF-Q II mass spectrometer with an electrospray ionization source (ESI-MS). The nominal resolution of the instrument was 17,500. The instrument was operated in positive ion mode with m/z range of 50-800. The capillary voltage was 4500 V, and the capillary exit was 166 V. The nebulizer gas pressure was 0.8 bars, and the drying gas flow was 4 L/min. The drying temperature was 250°C. The spectra average was set to 3, and the summation was 5,000, corresponding to 1 second sample time. The transfer time was 70 microseconds, and the hexapole RF was 100 Vpp.

UV spectra were recorded with a Perkin Elmer Lambda 50 UV/VIS spectrometer.

Microanalyses were performed on Carlo Erba 2700 II elemental analyzer.

The progress of the reactions and the purity of the compounds were monitored by TLC on TLC Silica gel 60 F₂₄₅ Aluminium sheets (Merck KGaA) in EtOAc-hexanes (5:1 or 4:1) system.

5-Methyl-1,2,3-triazole-4-carboxylates **1a-d**,¹ 5-methyl-1,2,3-thiadiazole-4-carboxylate **7**² and 1,2,3-triazole-4-carboxylate **3b**³ were prepared according to a literature procedures.

X-Ray experiment. X-Ray structural experiment was performed in Center of Joint Usage "Spectroscopy and Analysis of Organic Compounds" IOS UB RAS at 295(2) K on a Xcalibur S automatic single-crystal diffractometer at the standard procedure (graphite-monochromated MoK_α -radiation, ω -scanning technique with a step of 1°). Crystal data for **4a**: chemical formula $\text{C}_{26}\text{H}_{25}\text{N}_7\text{O}_4$, $M = 499.53$, crystal system triclinic, space group $P-1$, unit cell parameters: $a = 8.8237(7)$ Å, $b = 12.5753(9)$ Å, $c = 24.9768(16)$ Å, $\alpha = 83.919(6)^\circ$, $\beta = 83.430(6)^\circ$, $\gamma = 69.943(7)^\circ$, $V = 2579.7(3)$ Å³, $Z = 4$, $d_{\text{calc}} = 1.286$ g/cm³.

21816 Reflections were collected in the range of angles of $2.66^\circ < \theta < 26.37^\circ$, from which 10279 independent reflections ($R_{\text{int}} = 0.0362$) and 4680 with $I > 2\sigma(I)$. The completeness was 97.7% at the angles of $\theta \leq 26.37^\circ$. The structure was solved by direct methods and refined by full-matrix least-squares method using the SHELXTL program package⁴ in the anisotropic approximation for non-hydrogen atoms. Part of the protons were solved by the direct method and refined independently. The positions of the remaining H atoms were calculated geometrically and included in the refinement with the riding model.

Correction for absorption was not introduced ($\mu = 0.090$ mm⁻¹). The final refinement parameters were as follows: $R_1 = 0.0408$, $wR_2 = 0.0751$ for reflections with $I > 2\sigma(I)$; $R_1 = 0.1135$, $wR_2 = 0.0814$ for all reflections, $S = 1.000$. Largest difference peak and hole 0.236 and -0.220 eÅ⁻³.

Crystallographic data for compound 4a (CCDC deposition number 867109) have been deposited at the Cambridge Crystallographic Data Centre, 12 Union Road, Cambridge CB2 1EZ, UK.

Computational study.

Overall, eight isomers are possible considering the isomerization in unsaturated polyalkenes as shown at Figure S1. Evaluation of relative stability of isomers for compounds **4** and **9** were performed by the means of quantum chemical calculations. The calculations were performed by GAMESS-US software.⁵⁻⁶ Semi-empirical AM1 method was chosen based on available computational recourses and considering its great performance in calculations of heat of formation for oxygen, nitrogen and sulfur containing compounds.⁷⁻⁹ The standard procedure to locate minima was followed. Firstly, the full optimization following the gradient on potential energy surface were done. Then, Hessians for located saddle points were evaluated in order to prove that true minima were located.

According to our data thermodynamically preferred conformation for the product of condensation was *trans*-*E*-*cis* isomer, *Etc*. The difference between *Etc* isomer and other seven isomers for **4** and **9** were relatively small, $\sim \Delta\Delta G=0.1-2.0$ kcal/mol as per gas phase calculations.

Figure S1. Eight possible isomers. Five-membered ring stands for triazole or thiadiazol fragment.

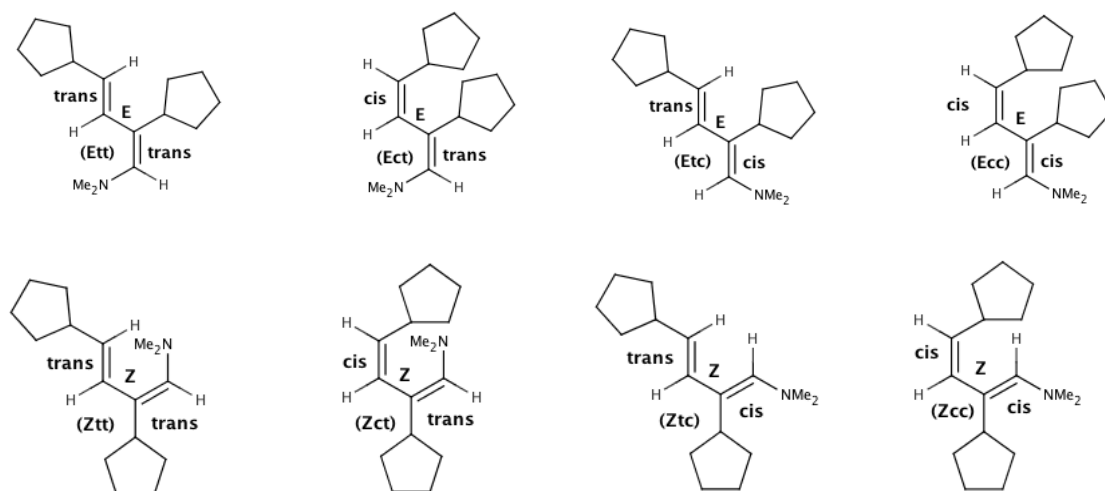


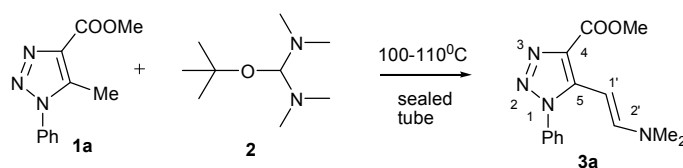
Table S1. Relative stability of possible isomers of **4** and **9** ($\Delta\Delta G$, kcal/mol)

isomers	4	9
<i>Ecc</i>	1.33	15.11
<i>Ect</i>	0.90	0.46
<i>Etc</i>	0.00	0.00
<i>Ett</i>	0.62	1.10

<i>Ztt</i>	0.51	1.99
<i>Ztc</i>	0.11	1.12
<i>Zct</i>	0.91	0.53
<i>Zcc</i>	1.08	1.77

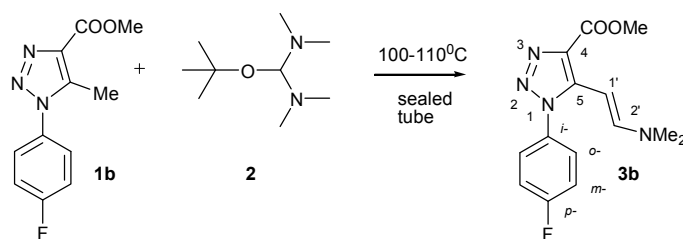
Synthetic experiments.

(E)-Methyl 5-(2-(dimethylamino)vinyl)-1-phenyl-1H-1,2,3-triazole-4-carboxylate (**3a**).



A mixture of methyl 1,2,3-triazole-4-carboxylate **1a** (0.65 g, 3.0 mmol) and Bredereck's reagent (**2**) (2.09 g, 12 mmol) was heated for 2.5 h at 100–110 °C in sealed tube. The reaction mixture was cooled to room temperature, diluted with chloroform and evaporated in vacuum to dryness. The residue was treated with ether and enamine **3a** was obtained. Yield 77 % (0.63 g); colorless precipitate; mp 142–145 °C. UV (isoPrOH): λ , nm (lg ϵ) = 335 (6.23), 225(6.22). ¹H NMR (400 MHz, DMSO-*d*₆): δ = 2.83 (s, 6H, N(Me)₂), 3.88 (s, 3H, OMe), 4.84 (d, *J* = 13.6 Hz, C_{1'}-H), 7.49 (d, *J* = 6.8 Hz, 2H, H_{Ar}), 7.58–7.62 (m, 3H, H_{Ar}), 7.87 (d, *J* = 13.6 Hz, 1H, C_{2'}-H). ¹³C NMR (100 MHz, DMSO-*d*₆): 51.3 (OCH₃), 77.4 (C_{1'}), 129.1 (C₅-triaz.), 129.7 (C_{Ar}), 136.2 (C₄-triaz.), 141.9 (C_{Ar}), 150.0 (C_{2'}), 162.5 (C=O). ESI-MS: *m/z* = 273.13 [M + H]⁺. Anal. Calcd (%) for C₁₄H₁₆N₄O₂: C, 61.75; H, 5.92; N, 20.57. Found: C, 61.44; H, 5.54; N, 20.49.

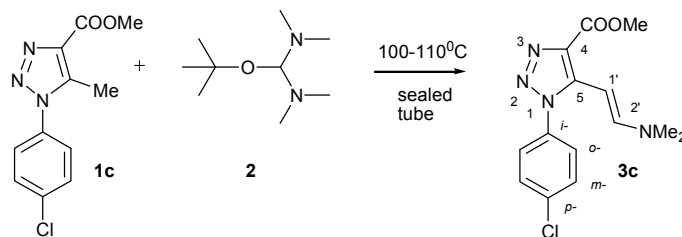
(E)-Methyl 5-(2-(dimethylamino)vinyl)-1-(4-fluorophenyl)-1H-1,2,3-triazole-4-carboxylate (**3b**).³



A mixture of methyl 1,2,3-triazole-4-carboxylate **1b** (0.7 g, 3.0 mmol) and Bredereck's reagent (**2**) (2.09 g, 12 mmol) was heated for 2.5 h at 100–110 °C in sealed tube. The reaction mixture was cooled to room temperature, diluted with chloroform and evaporated in vacuum to dryness. The residue was treated with ether and enamine **3b** was obtained. Yield 75 % (0.65 g); colorless precipitate; mp 146 °C (lit. 145–146 °C). ¹H NMR (400 MHz, DMSO-*d*₆): δ = 2.77 (br. s, 6H, N(Me)₂), 3.85 (s, 3H, OMe), 4.82 (d, *J* = 13.4

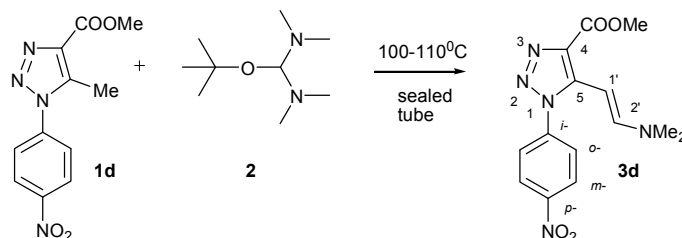
Hz, C₁-H), 7.62–7.47 (m, 4H, H_{Ar}), 7.71 (d, *J* = 13.4 Hz, 1H, C₂-H). Anal. Calcd (%) for C₁₄H₁₅FN₄O₂: C, 57.92; H, 5.21; N, 19.30. Found: C, 57.84; H, 5.01; N, 19.38.

(E)-Methyl 1-(4-chlorophenyl)-5-(2-(dimethylamino)vinyl)-1H-1,2,3-triazole-4-carboxylate (3c).



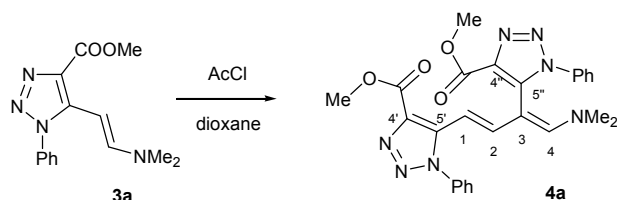
A mixture of methyl 1,2,3-triazole-4-carboxylate **1c** (0.755 g, 3.0 mmol) and Brederick's reagent (**2**) (2.09 g, 12 mmol) was heated for 2.5 h at 100–110 °C in sealed tube. The reaction mixture was cooled to room temperature, diluted with chloroform and evaporated in vacuum to dryness. The residue was treated with ether and enamine **3c** was obtained. Yield 84 % (0.77 g); pale yellow precipitate; mp 139–141 °C. ¹H NMR (400 MHz, DMSO-*d*₆): δ = 2.85 (s, 6H, N(Me)₂), 3.86 (s, 3H, OMe), 4.76 (d, *J* = 13.2 Hz, 1H, C₁-H), 7.52 (d, *J* = 8.8 Hz, 2H, H_{Ar}), 7.61 (d, *J* = 8.8 Hz, 2H, H_{Ar}), 8.00 (d, *J* = 13.2 Hz, 1H, C₂-H). ¹³C NMR (100 MHz, CDCl₃): 39.7 (br. s., N(CH₃)₂), 51.8 (OCH₃), 78.5 (C_(1')), 126.2 (C_{Ar}), 129.5 (C_{Ar}), 129.5 (C_{Ar}), 130.1 (C₍₅₎-triaz.), 136.7 (C₍₄₎-triaz.), 142.4 (C_{Ar}), 149.3 (C₍₂₎), 163.3 (C=O). ESI-MS: *m/z* = 307.09 [M + H]⁺. Anal. Calcd (%) for C₁₄H₁₅ClN₄O₂: C, 54.82; H, 4.93; N, 18.26. Found: C, 54.57; H, 5.02; N, 18.17.

(E)-Methyl 5-(2-(dimethylamino)vinyl)-1-(4-nitrophenyl)-1H-1,2,3-triazole-4-carboxylate (3d).



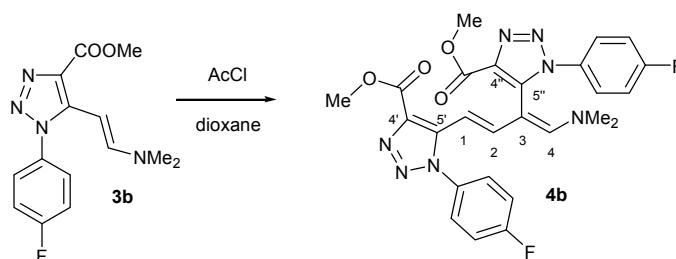
A mixture of methyl 1,2,3-triazole-4-carboxylate **1d** (0.79 g, 3.0 mmol) and Brederick's reagent (**2**) (2.09 g, 12 mmol) was heated for 2.5 h at 100–110 °C in sealed tube. The reaction mixture was cooled to room temperature, diluted with chloroform and evaporated in vacuum to dryness. The residue was treated with ether and enamine **3d** was obtained. Yield 82 % (0.78 g); yellow precipitate; mp 188–190 °C. ¹H NMR (400 MHz, DMSO-*d*₆): δ = 2.88 (s, 6H, N(Me)₂), 3.87 (s, 3H, OMe), 4.82 (d, *J* = 13.6 Hz, 1H, C₁-H), 7.86 (d, *J* = 8.8 Hz, 2H, H_{Ar}), 7.08 (d, *J* = 13.6 Hz, 1H, C₂-H), 8.45 (d, *J* = 8.8 Hz, 2H, H_{Ar}). ESI-MS: *m/z* = 318.11 [M + H]⁺. Anal. Calcd (%) for C₁₄H₁₅N₅O₄: C, 52.99; H, 4.76; N, 22.07. Found: C, 52.63; H, 4.47; N, 22.12.

Dimethyl 5,5'-((1E,3Z)-4-(dimethylamino)buta-1,3-diene-1,3-diyl)bis(1-phenyl)-1H-1,2,3-triazole-4-carboxylate (4a).



To a solution of enamine **3a** (0.17 g, 0.62 mmol) in anhydrous dioxane (4.5 mL), acetyl chloride (0.093 mL, 1.3 mmol) was added and the reaction mixture was stirred at room temperature for 24 h. Then triethyl amine (0.19 mL, 1.36 mmol) was added and the mixture was stirred for 15 min. The resulting mixture was evaporated under reduced pressure to dryness and residue was purified by column chromatography over silica gel (60–120) using EtOAc–hexanes (5:1) as eluent to give the diene **4a**. Yield 84 % (0.13 g); yellow solid; mp 170–173°C. UV (isoPrOH): λ , nm (lg ϵ) = 374 (6.27), 243 (6.27). ^1H NMR (400 MHz, DMSO- d_6): δ = 2.66 (s, 6H, N(Me) $_2$), 3.86 (s, 3H, OMe), 3.87 (s, 3H, OMe), 5.07 (d, J = 15.6 Hz, 1H, C $_{(1)}$ -H), 6.68 (s, 1H, C $_{(4)}$ -H), 7.22 (d, J = 15.6 Hz, 1H, C $_{(2)}$ -H), 7.26–7.28 (m, 2H, H $_{\text{Ar}}$), 7.39–7.41 (m, 2H, H $_{\text{Ar}}$), 7.49–7.51 (m, 3H, H $_{\text{Ar}}$), 7.53–7.57 (m, 3H, H $_{\text{Ar}}$). ^{13}C NMR (100 MHz, DMSO- d_6): δ = 40.1 (N(Me) $_2$), 51.7 (OMe), 51.9 (OMe), 91.0 (C $_{(3)}$), 97.2 (C $_{(1)}$), 123.9 (C $_{\text{Ar}}$), 125.8 (C $_{\text{Ar}}$), 129.6 (C $_{\text{Ar}}$), 129.7 (C $_{\text{Ar}}$), 129.9 (C $_{\text{Ar}}$), 130.0 (C $_{\text{Ar}}$), 132.2 (C $_{(4')}$ -triaz.), 135.4 (C $_{(5')}$ -triaz.), 135.8 (C $_{(4')}$ -triaz.), 137.1 (C $_{\text{Ar}}$), 138.4 (C $_{(5')}$ -triaz.), 140.1 (C $_{\text{Ar}}$), 143.6 (C $_{(2)}$), 150.4 (C $_{(4)}$), 160.6 (C=O), 161.8 (C=O). ESI-MS: m/z = 500.20 [M + H] $^+$. Anal. Calcd (%) for C $_{26}$ H $_{25}$ N $_7$ O $_4$: C, 62.52; H, 5.04; N, 19.63. Found: C, 61.93; H, 4.96; N, 19.67.

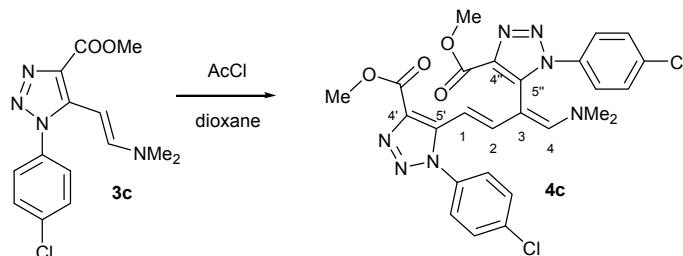
Dimethyl 5,5'-((1E,3Z)-4-(dimethylamino)buta-1,3-diene-1,3-diyl)bis(1-(4-fluorophenyl)-1H-1,2,3-triazole-4-carboxylate (4b)).



To a solution of enamine **3b** (0.07 g, 0.24 mmol) in anhydrous dioxane (2 mL), acetyl chloride (0.041 g, 0.52 mmol) was added. Reaction mixture was stirred at room temperature for 24 h. Volatiles were evaporated to dryness, residue was purified by column chromatography over silica gel (60–120) using EtOAc–hexanes (1:1 to 1:0) as eluent to give the diene **4b**. Yield 56 % (0.036 g); yellow tiny powder; mp 163–164 °C. UV (isoPrOH): λ , nm (lg ϵ) = 360 (6.07), 246 (5.95). ^1H NMR (400 MHz, CDCl $_3$): δ = 2.62 (s, 6H, N(Me) $_2$), 3.94 (s, 3H, OMe), 3.95 (s, 3H, OMe), 5.11 (d, J = 15.6 Hz, 1H, C $_{(1)}$ -H), 6.60 (s, 1H, C $_{(4)}$ -H), 7.10–7.18 (m, 4H, H $_{\text{Ar}}$), 7.24–7.31 (m, 1H, H $_{\text{Ar}}$), 7.35–7.41 (m, 1H, H $_{\text{Ar}}$), 7.46–7.49 (m, 2H, H $_{\text{Ar}}$), 7.58 (d, J = 15.6 Hz, 1H, C $_{(2)}$ -H). ^{13}C NMR (100 MHz, DMSO- d_6): δ = 41.7 (N(Me) $_2$), 51.6 (OMe), 51.9 (OMe), 90.7 (C $_{(3)}$), 97.2 (C $_{(1)}$), 116.58 (C $_{\text{Ar}}$), 116.61 (C $_{\text{Ar}}$), 126.4 (C $_{\text{Ar}}$), 128.4 (C $_{\text{Ar}}$), 131.7 (C $_{\text{Ar}}$), 132.2 (C $_{(4')}$), 132.3 (C $_{\text{Ar}}$), 137.4 (C $_{(4')}$), 138.5 (C $_{(5')}$), 140.3 (C $_{(5')}$), 143.4 (C $_{(2)}$), 150.4 (C $_{(4)}$), 160.5 (C=O), 161.8

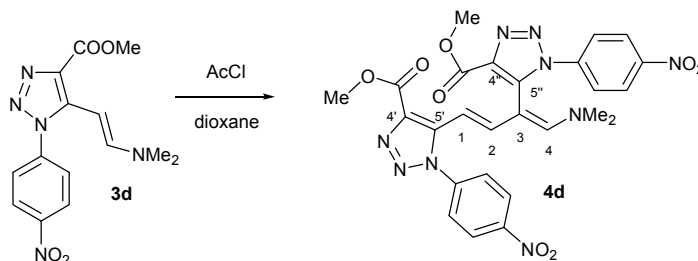
(C=O), 163.4 (2C_{Ar}). ¹⁹F NMR (376 MHz, CDCl₃): δ = -110.22 (s, 1F), -109.80 (s, 1F). ESI-MS, *m/z* = 536.1869 [M+H]⁺.

Dimethyl 5,5'-((1E,3Z)-4-(dimethylamino)buta-1,3-diene-1,3-diyl)bis(1-(4-chlorophenyl)-1H-1,2,3-triazole-4-carboxylate (4c).



To a solution of enamine **3c** (0.07 g, 0.228 mmol) in anhydrous dioxane (2 mL), acetyl chloride (0.034 mL, 0.8 mmol) was added and the reaction mixture was stirred at room temperature for 24 h. Then triethyl amine (0.083 mL, 0.82 mmol) was added and the mixture was stirred for 15 min. The resulting mixture was evaporated under reduced pressure to dryness and residue was purified by column chromatography over silica gel (60–120) using EtOAc–hexanes (3:1) as eluent to give the diene **4c**. Yield 62 % (0.041 g); yellow solid; mp 165–167 °C. UV (isoPrOH): λ, nm (lg ε) = 373 (5.87), 246 (6.10). ¹H NMR (400 MHz, DMSO-*d*₆): δ = 2.66 (s, 6H, N(Me)₂), 3.85 (s, 3H, OMe), 3.87 (s, 3H, OMe), 5.07 (d, *J* = 16.0 Hz, 1H, C₍₁₎-H), 6.74 (s, 1H, C₍₄₎-H), 7.10 (d, *J* = 16.0 Hz, 1H, C₍₂₎-H), 7.35 (d, *J* = 8.8 Hz, 2H, H_{Ar}), 7.48 (d, *J* = 8.8 Hz, 2H, H_{Ar}), 7.53–7.57 (m, 4H, H_{Ar}). ¹³C NMR (100 MHz, CDCl₃): δ = 42.2 (N(Me)₂), 52.0 (OMe), 52.1 (OMe), 92.2 (C₍₃₎), 99.4 (C₍₁₎), 120.0 (C_{Ar}), 124.8 (C_{Ar}), 126.8 (C_{Ar}), 129.7 (C_{Ar}), 134.4 (C_{Ar}), 134.6 (C_{Ar}), 134.8 (C_(4')), 135.8 (C_{Ar}), 135.83 (C_{Ar}), 136.8 (C_(5')), 139.4 (C_(4')), 140.2 (C_(5')), 144.0 (C₍₂₎), 149.6 (C₍₄₎), 161.0 (C=O), 162.4 (C=O). ESI-MS: *m/z* = 568.12 [M + H]⁺. Anal. Calcd (%) for C₂₆H₂₃ClN₇O₄: C, 54.94; H, 4.08; N, 17.25. Found: C, 54.39; H, 3.98; N, 17.21.

Dimethyl 5,5'-((1E,3Z)-4-(dimethylamino)buta-1,3-diene-1,3-diyl)bis(1-(4-nitrophenyl)-1H-1,2,3-triazole-4-carboxylate (4d).

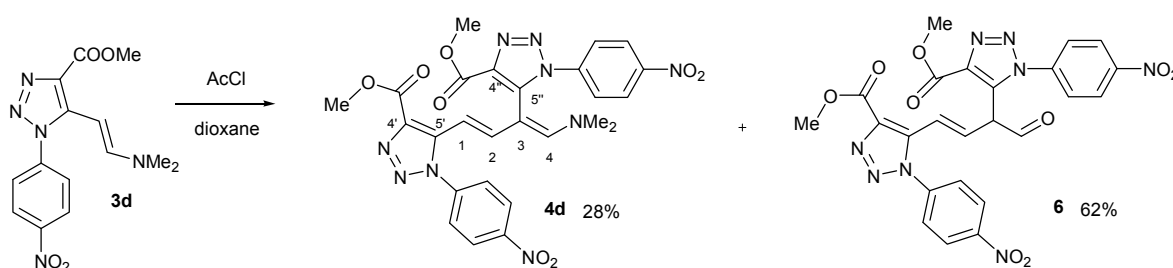


Method A. To a solution of enamine **3d** (0.1 g, 0.315 mmol) in anhydrous dioxane (4 mL), acetyl chloride (0.047 mL, 0.66 mmol) was added and the reaction mixture was stirred at room temperature for 24 h. Then triethyl amine (0.08 mL, 0.8 mmol) was added and the mixture was stirred for 15 min. The resulting mixture was evaporated under reduced pressure to dryness and residue was purified by column chromatography over silica gel (60–120) using EtOAc–hexanes (3:1) as eluent to give the diene **4d**. Yield

65 % (0.06 g); orange solid; mp 207–210 °C. UV (isoPrOH): λ , nm ($\lg \epsilon$) = 405 (shoulde) (5.89), 326 (6.20), 272 (6.45). NMR (400 MHz, DMSO- d_6): δ = 2.66 (s, 6H, N(Me) $_2$), 3.88 (s, 3H, OMe), 3.91 (s, 3H, OMe), 5.18 (d, J = 16.0 Hz, 1H, C $_{(1)}$ -H), 6.84 (s, 1H, C $_{(4)}$ -H), 7.04 (d, J = 16.0 Hz, 1H, C $_{(2)}$ -H), 7.70 (d, J = 8.8 Hz, 2H, H $_{Ar}$), 7.86 (d, J = 8.8 Hz, 2H, H $_{Ar}$), 8.39–8.41 (m, 4H, H $_{Ar}$). 13 C NMR (100 MHz, DMSO- d_6): δ = 41.8 (N(Me) $_2$), 51.7 (OMe), 52.1 (OMe), 90.1 (C $_{(3)}$), 96.8 (C $_{(1)}$), 124.9 (C $_{Ar}$), 125.0 (C $_{Ar}$), 125.2 (C $_{Ar}$), 126.9 (C $_{Ar}$), 132.8 (C $_{(4')}$), 137.4 (C $_{(5')}$), 138.9 (C $_{(4'')}$), 139.9 (C $_{Ar}$), 140.3 (C $_{(5'')}$), 141.0 (C $_{Ar}$), 143.8 (C $_{(2)}$), 147.6 (C $_{Ar}$), 147.8 (C $_{Ar}$), 151.2 (C $_{(4)}$), 160.3 (C=O), 161.5 (C=O). ESI-MS: m/z = 590.17 [M + H] $^+$. Anal. Calcd (%) for C $_{26}$ H $_{23}$ N $_9$ O $_8$: C, 52.97; H, 3.93; N, 21.38. Found: C, 52.61; H, 4.06; N, 21.30.

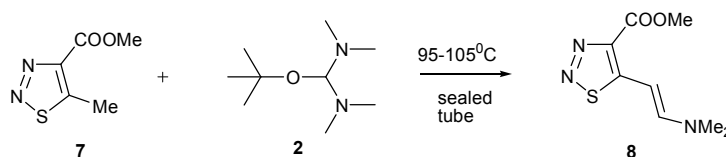
Method B. To a solution of enamine **3d** (0.317 g, 1.0 mmol) in anhydrous dioxane (6 mL), acetyl chloride (0.173 mL, 2.2 mmol) was added and the reaction mixture was stirred at room temperature for 24 h. The reaction mixture was diluted with ether. The formed precipitate was filtered off, washed with NaHCO $_3$ (5% water solution) and then with water and dried in vacuum over KOH. Yield 71 % (0.21 g); orange solid; mp 207–210 °C.

Dimethyl 5,5'-((1E,3Z)-4-hydroxybuta-1,3-diene-1,3-diyl)bis(1-(4-nitrophenyl)-1H-1,2,3-triazole-4-carboxylate) (6).



A solution of enamine **3d** (0.317 g, 1.0 mmol) in glacial HOAc (3 mL) was stirred at room temperature for 3 days. The reaction mixture was diluted with ether (1.5 mL). The formed precipitate was filtered off and dissolved in chloroform (20 mL), diluted with water (20 mL) and neutralize with NaHCO $_3$ (aq. solution) till pH 6. The organic phase was dried over MgSO $_4$ and the solvent was evaporated till dryness. The residua contain two products which was separated by flash chromatography over silica gel (60–120) using chloroform–acetone (2:1) as eluent to give diene **4d** (0.084 g, 28%) (first fraction) and product **6** (yellow solid, 0.175 g, 62%) (second fraction). ESI-MS: m/z = 563.12 [M + H] $^+$.

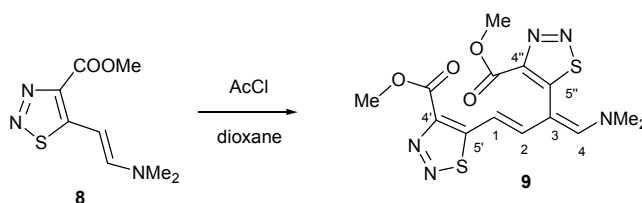
Methyl 5-[(E)-2-(dimethylamino)vinyl]-1,2,3-thiadiazole-4-carboxylate (8).



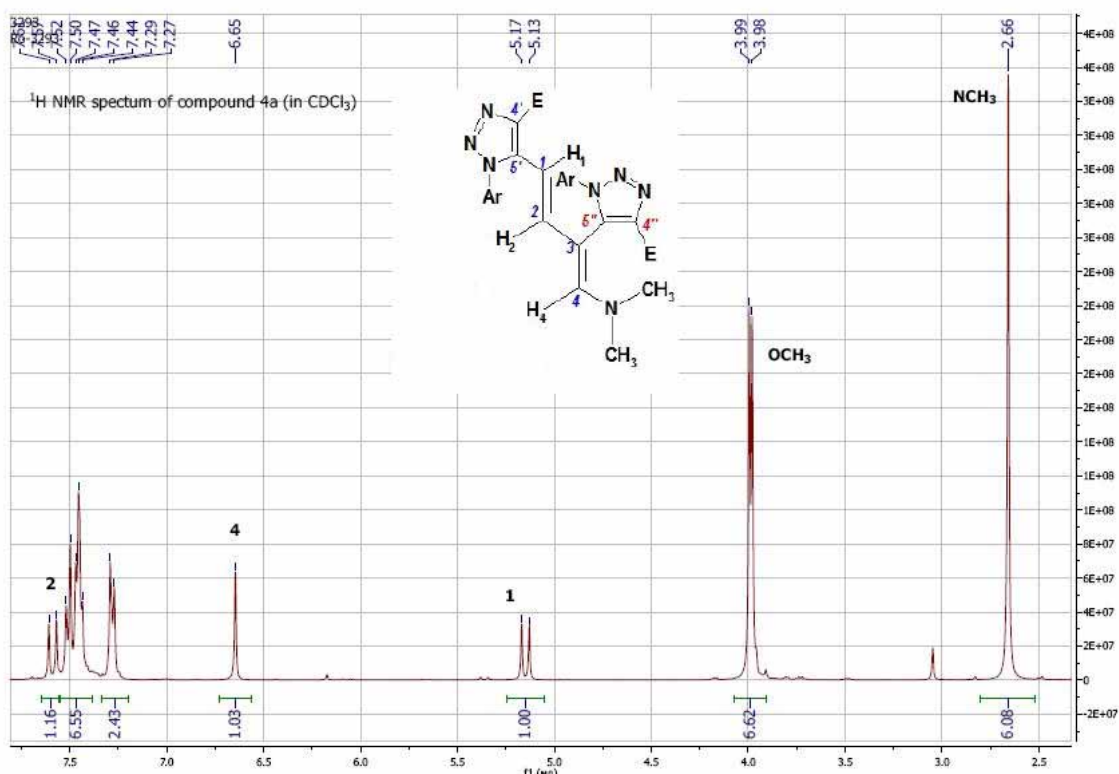
A mixture of methyl 5-methyl-1,2,3-thiadiazole-4-carboxylate (**7**) (0.7 g, 4.4 mmol) and Bredereck's reagent (**2**) (1.65 g, 7.7 mmol) was heated in sealed tube at 95–105 °C for 8 h. The reaction mixture was

cooled, diluted with CHCl_3 and evaporated in vacuum. The compound **8** was purified by column chromatography on silica gel using $\text{CCl}_4/\text{CHCl}_3$ as eluent. The crude product was crystallized from ethanol. Yield 65 % (0.614 g); yellow solid; mp 133–135 °C. ^1H NMR (400 MHz, $\text{DMSO}-d_6$): δ = 7.34 (d, 1H, $J=13.2$ Hz, =CH), 6.17 (d, 1H, $J=13.2$ Hz, =CH), 3.90 (s, 3H, OMe), 3.05 (s, 6H, NMe_2). ESI-MS: m/z = 214.06 $[\text{M} + \text{H}]^+$. Anal. Calcd (%) for $\text{C}_8\text{H}_{11}\text{N}_3\text{O}_2\text{S}$: C, 45.06; H, 5.20; N, 19.70. Found: C, 45.17; H, 5.17; N 19.65.

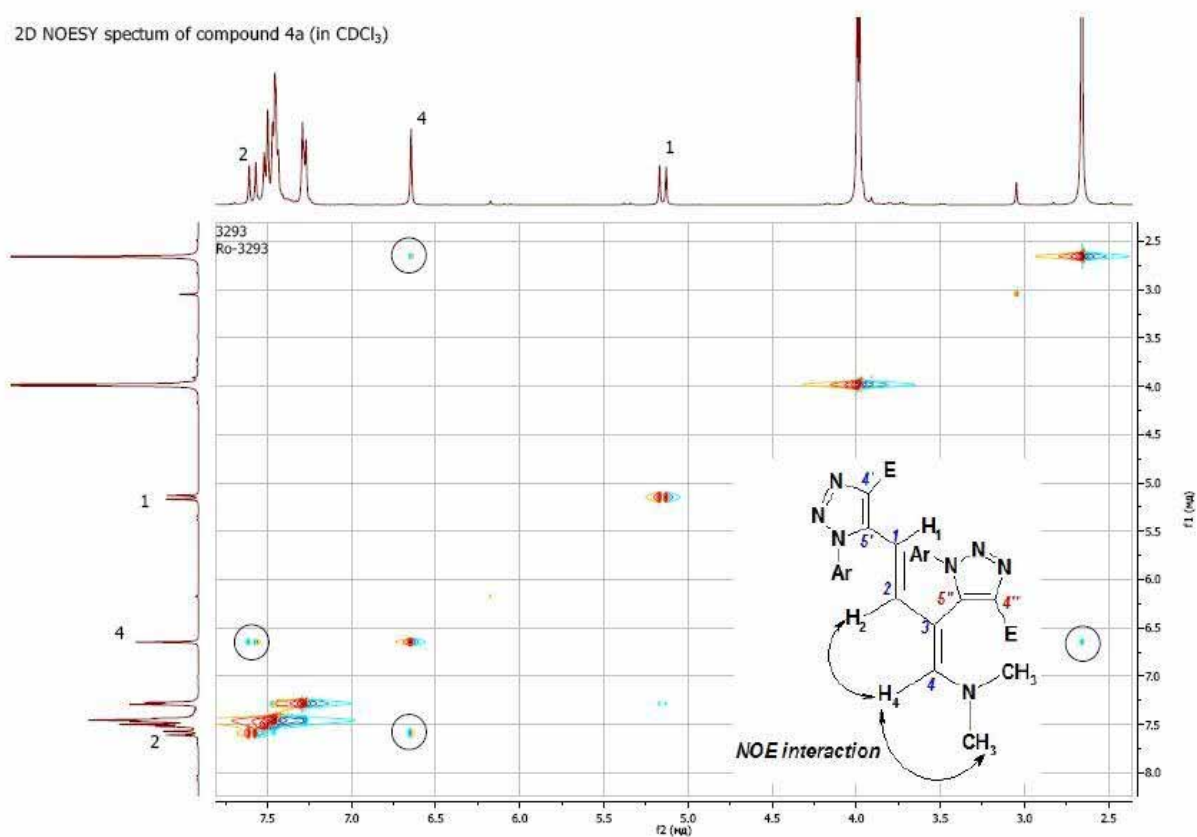
Methyl 5-{(1E,3E)-4-(dimethylamino)-3-[4-(methoxycarbonyl)-1,2,3-thiadiazol-5-yl]buta-1,3-dienyl}-1,2,3-thiadiazole-4-carboxylate (9).

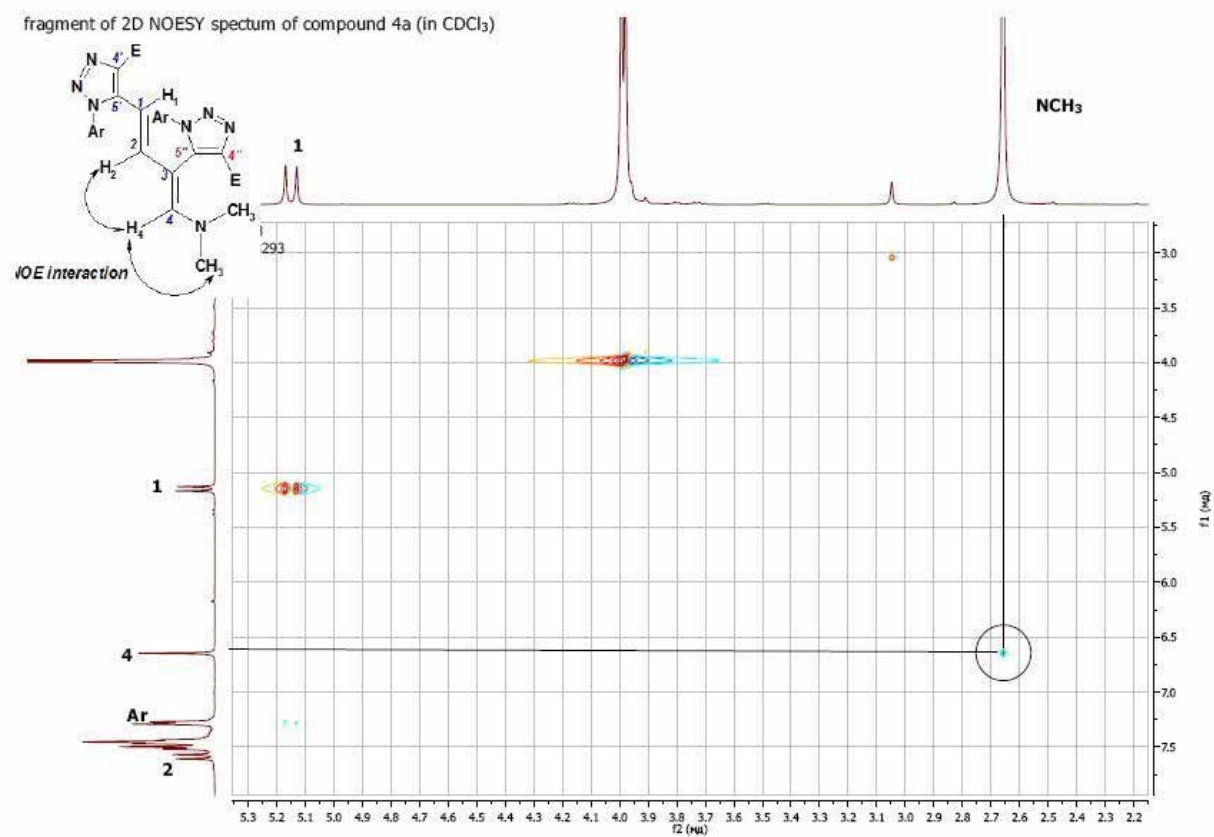
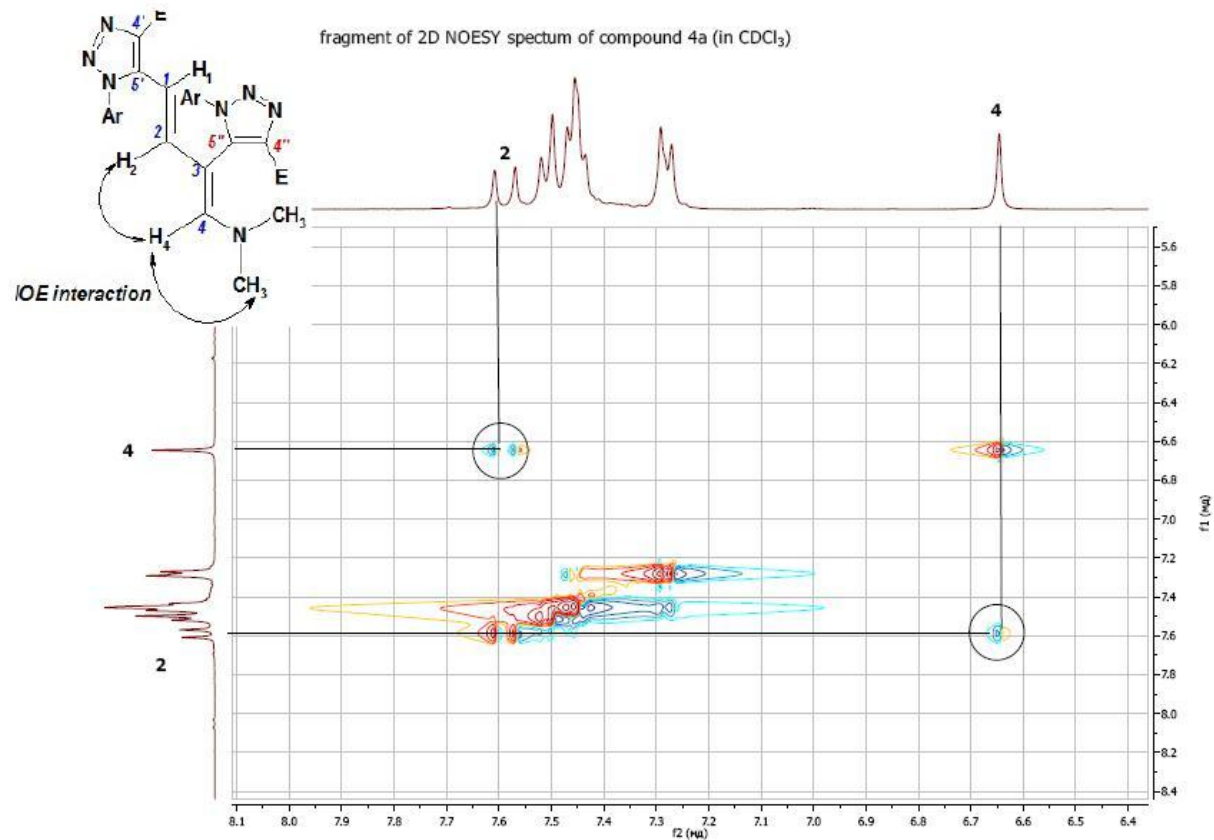


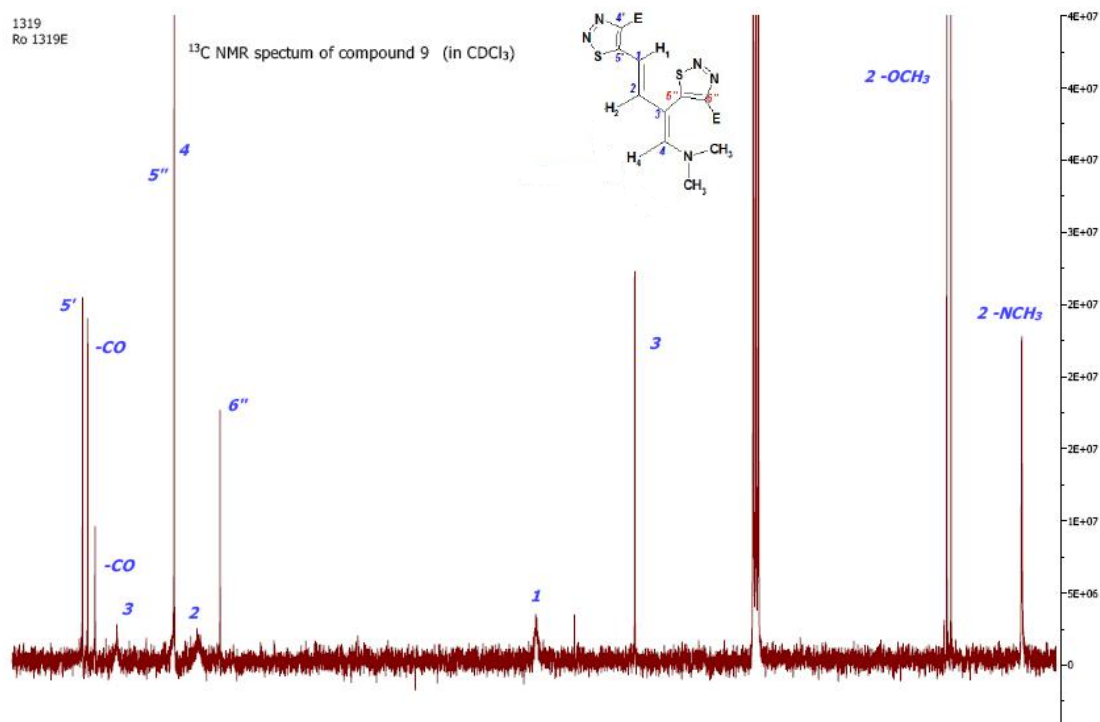
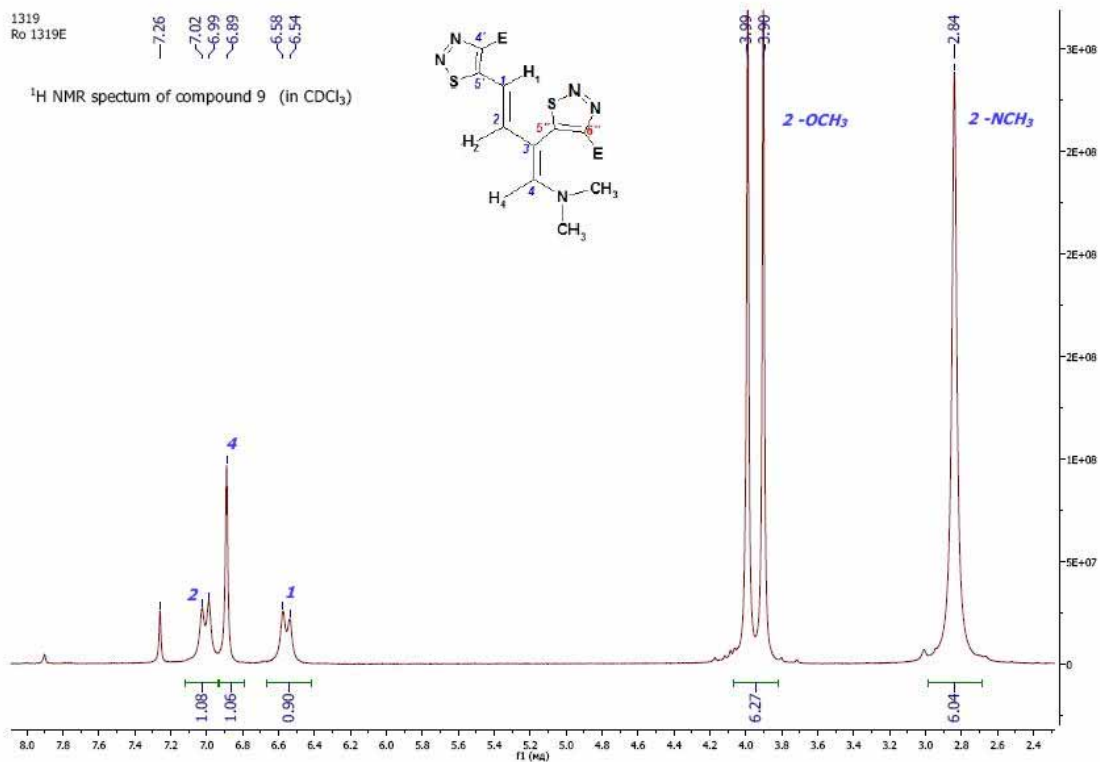
To a solution of 1,2,3-thiadiazole-4-carboxylate **8** (0.213 g, 1.0 mmol) in 6 ml of anhydrous dioxane was added AcCl (0.244 g, 3.0 mmol). The reaction mixture was stirred at room temperature for 24 h. Then it was diluted with CHCl_3 (50 ml). The solution was washed twice with water (20 ml), dried with Na_2SO_4 and evaporated in vacuum. The crude product was purified by column chromatography on silica gel using $\text{CHCl}_3/\text{acetone}$ (25/1) as eluent to give the diene **9**. Yield 80% (0.153 g); orange solid; mp 138 °C. UV (isoPrOH): λ , nm ($\lg \epsilon$) = 435 (6.35), 291 (6.30). ^1H NMR (400 MHz, $\text{DMSO}-d_6$): δ 2.85 (s, 6H, NMe_2), 3.91 (s, 3H, OMe), 6.32 (d, 1H, $J=15.2$ Hz, $\text{C}_{(1)}$ -H), 7.26 (d, 1H, $J=15.2$ Hz, $\text{C}_{(2)}$ -H), 7.40 (s, 1H, $\text{C}_{(4)}$ -H). ^{13}C NMR (100 MHz, $\text{DMSO}-d_6$): δ = 42.9 (NMe_2), 52.0 (OCH_3), 52.7 (OCH_3), 91.8 ($\text{C}_{(3)}$), 101.2 ($\text{C}_{(1)}$), 143.2 ($\text{C}_{(4')}$), 150.0 ($\text{C}_{(2)}$), 150.7 ($\text{C}_{(4'')}$), 153.4 ($\text{C}_{(4)}$), 157.8 ($\text{C}_{(5'')}$), 160.1 ($\text{C}=\text{O}$), 161.3 ($\text{C}=\text{O}$), 162.6 ($\text{C}_{(5')}$). Anal. Calcd (%) for $\text{C}_{14}\text{H}_{15}\text{N}_5\text{O}_4\text{S}_2$: C, 44.09; H, 3.96; N, 18.36. Found: C, 43.79; H, 4.02; N 18.24. ESI-MS: m/z = 382.06 $[\text{M} + \text{H}]^+$.



2D NOESY spectrum of compound 4a (in CDCl₃)



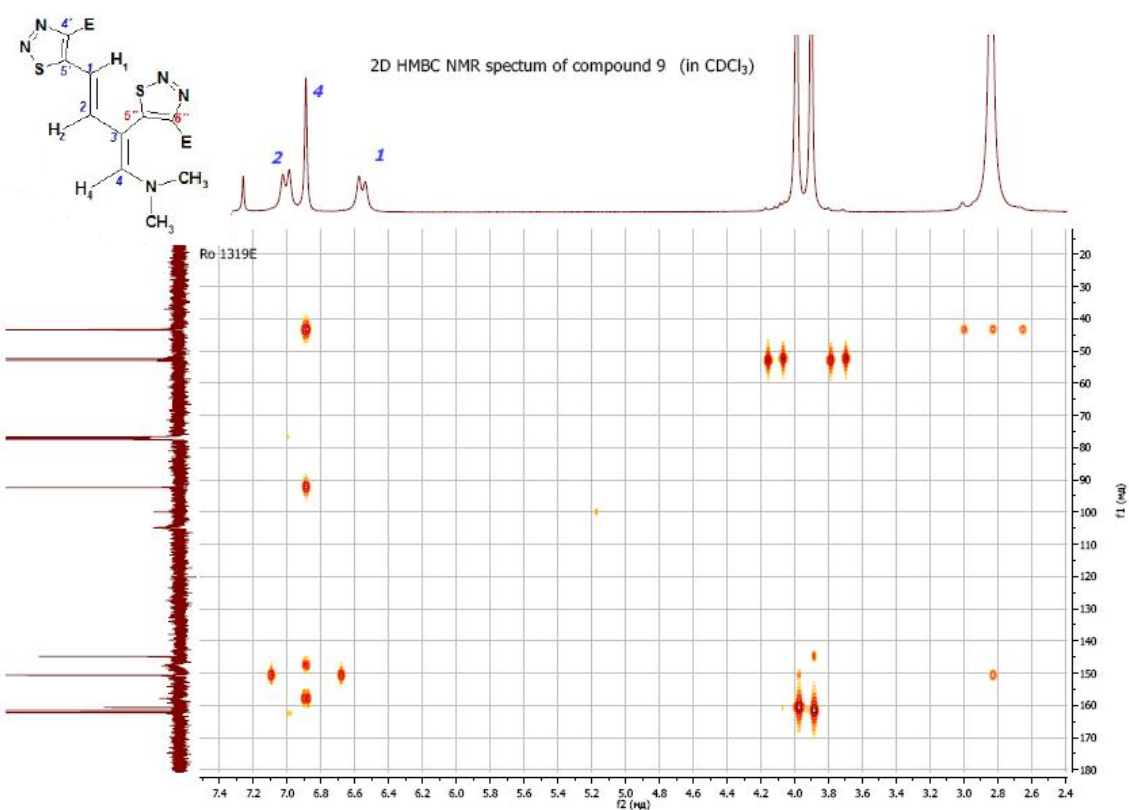
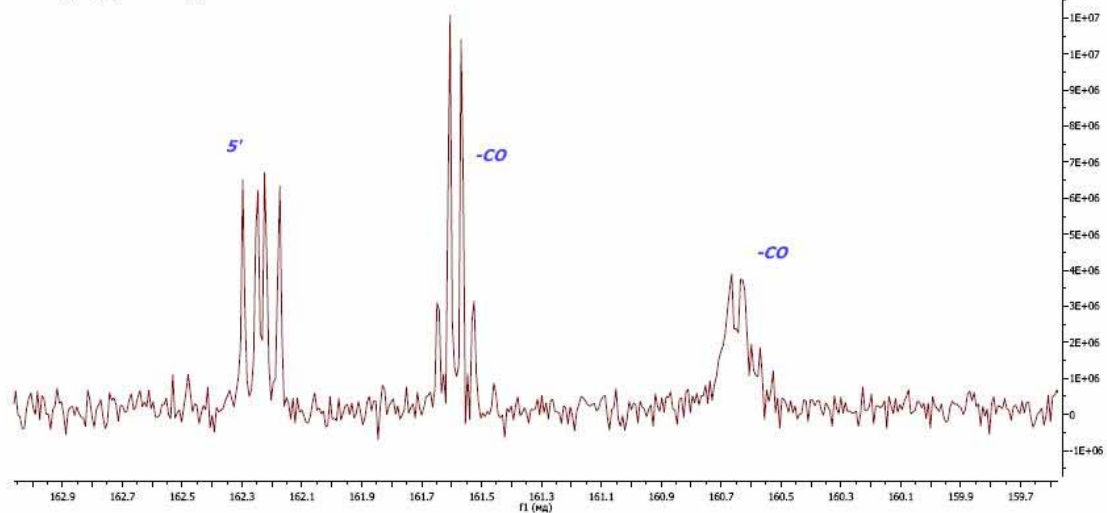




1319
Ro 1319E



¹³C NMR spectrum of compound 9
(gate) (in CDCl₃)



References for supplementary section.

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