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Synthesis of 1-Substituted Pyrazolines by Reaction of Donor-Acceptor Cyclopropanes with 1,5-Diazabicyclo[3.1.0]hexanes

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Abstract: Substituted pyrazolines were obtained by $Ni(ClO_4)_2 \cdot 6H_2O$-catalyzed reaction of 1,5-diazabicyclo[3.1.0]hexanes with donor-acceptor cyclopropanes. The mechanism of this reaction includes alkylation of diaziridine nitrogen with Lewis acid-activated donor-acceptor cyclopropane followed by hydration of the formed 1,6-zwitterionic intermediate and oxidation of pyrazolidine with air oxygen. This pathway is realized when starting bicyclic diaziridines have bulky alkyl substituent(s) at the C(6) atom preventing (3+3)-annulation of two three-membered rings.

Introduction

Azaheterocyclic scaffolds are present in more than half of small molecules approved for the use as pharmaceuticals.[1] Among them, pyrazolines (2,3-dihydro-1*H*-pyrazoles) occupy an important place. In particular, *edaravone* is used for the treatment of amyotrophic lateral sclerosis[2] and to assist the recovery of patients after a cerebral ischemic stroke,[3] *eltrombopag* is efficient for the treatment of idiopathic thrombocytopenic purpura[4] and hepatitis C-induced cirrhosis,[5] *muzolimine* is a diuretic,[6] *rosonabant*, *ibipinabant* and related compounds efficiently bind to cannabinoid CB_1 receptor providing appetite suppressant effect,[7] some other pyrazolines were found to demonstrate antimicrobial,[8] anti-inflammatory,[9] antiamoebic,[10] and other bioactivities.[11] Some of these compounds are given in Fig. 1. Pyrazoline-based tartrazine and Orange B are food dyes while Mordant red 19 and Sudan Yellow 3G are applied as industrial azo dyes.[12] Moreover, pyrazolines can be used as starting compounds for the synthesis of unnatural amino acid azaproline and its derivatives.[13]

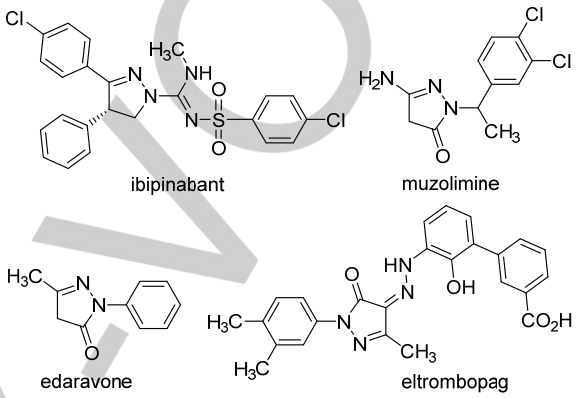

Figure 1. Examples of pyrazoline-based bioactive compounds.

The most common methods for the synthesis of pyrazolines derivatives are reactions of hydrazines with α,β-unsaturated ketones or β-ketoesters affording 2,3-dihydro-1*H*-pyrazoles and pyrazolin-3-ones respectively.[14,15] Nevertheless, these methods cannot be used for the preparation of pyrazolines bearing no substituents at α-positions to both endocyclic nitrogen atoms despite the potent importance of such compounds.[13,16]

Very recently, we have described the reaction of donor-acceptor (D–A) cyclopropanes[17,18] **1** with bicyclic diaziridines **2**[19] affording hexahydropyridazines **3** as a first example of (3+3)-annulation of two different three-membered rings (Scheme 1a).[20] However, under the same conditions spiro[cyclohexane-1,6'-(1,5-diazabicyclo[3.1.0]hexane)] **2a** did not produce the corresponding hexahydropyridazine affording other product. This stimulated us to investigate the reaction in more detail to determine the alternative pathway of the reaction between **1** and **2**. During this study we have found that **2a** and some other 1,5-diazabicyclo[3.1.0]hexanes bearing bulky substituents at the C(3) atom of the diaziridine ring were converted into 1-alkylated 2,3-dihydropyrazoles in the reaction with D–A cyclopropanes (Scheme 1b). Nevertheless, the nature of donor substituent in cyclopropane influences the reaction chemoselectivity. Here, we report results of this study.

Results and Discussion

We started our investigation by optimization of reaction conditions for the model reaction between dimethyl 2-(4-methylphenyl)cyclopropane-1,1-dicarboxylate **1a** and bycyclic diaziridine **2a** (Table 1).

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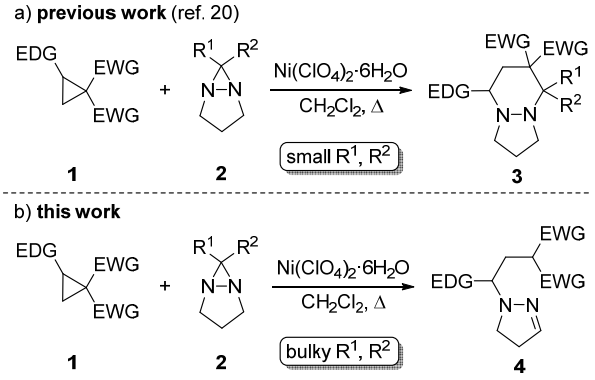
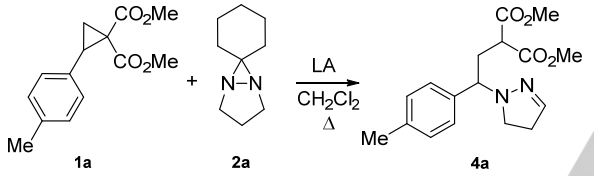


Scheme 1. The reaction of D–A cyclopropanes **1** with a series of 1,5-diazabicyclo[3.1.0]hexanes **2**. a) (3+3)-Annulation of two three-membered rings affording hexahydropyridazine derivatives **3**.[20] b) 2,3-Dihydro-1*H*-pyrazolines **4** formation (this work).

Table 1. Optimization of reaction conditions for the model reaction between cyclopropane **1a** and diaziridine **2a**.[a]

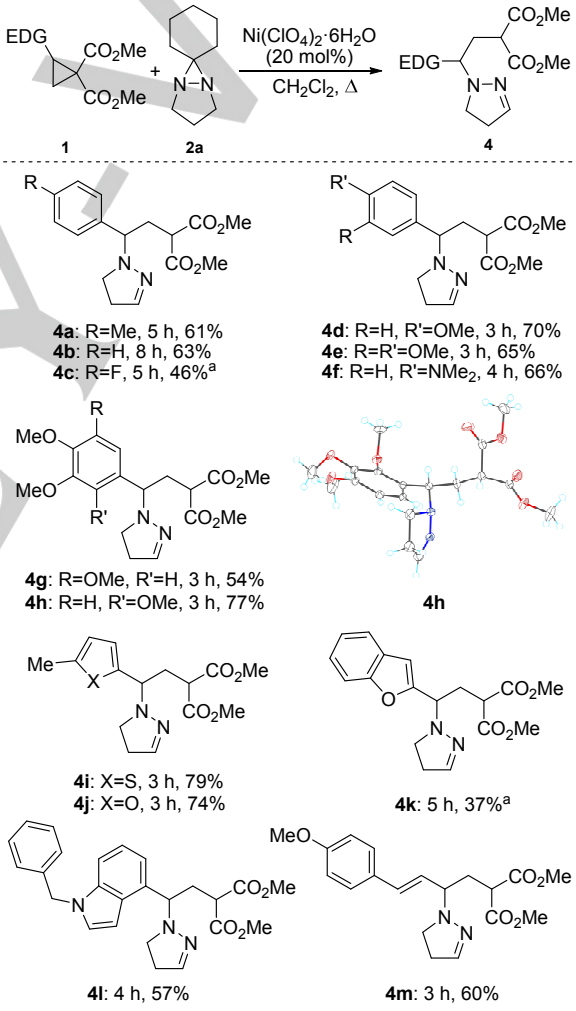


Entry	Lewis acid (mol %)	**2a**/**1a** ratio	time, h	Yield of **4a**, %[b]
1	$Sc(OTf)_3$ (10 mol%)	1	3	traces[c]
2	$Sn(OTf)_2$ (10 mol%)	1	3	NR[d]
3	$Yb(OTf)_3$ (10 mol%)	2.5	3	9[e]
4	$InCl_3$ (20 mol%)	2.5	3	NR[d]
5	$Ni(OTf)_2$ (10 mol%)	2.5	3	NR[d]
6	$Ni(ClO_4)_2·6H_2O$ (20 mol%)	1	3	15[f]
7	$Ni(ClO_4)_2·6H_2O$ (20 mol%)	1.5	3	35[g]
8	$Ni(ClO_4)_2·6H_2O$ (20 mol%)	2.5	1[h]	23
9	$Ni(ClO_4)_2·6H_2O$ (20 mol%)	2.5	3	47
10	$Ni(ClO_4)_2·6H_2O$ (20 mol%)	2.5	5	68 (61[i])

[a] 0.05 M solution of **1a** in CH_2Cl_2, Lewis acid, portionwise addition of **2a** (0.25 equiv every 15 min), molecular sieves 4Å, CH_2Cl_2, reflux. [b] NMR yield. [c] Cyclopropane conversion did not exceed 5%. [d] NR = no reaction. [e] Cyclopropane conversion was 24%; yield based on reacted starting material (brsm) = 38%. [f] Cyclopropane conversion was 27%; brsm yield = 56%. [g] Cyclopropane conversion was 47%; brsm yield = 74%. [h] Reaction was performed in 1,2-dichloroethane. [i] Isolated yield.

We found that indium(III) chloride and nickel(II) triflate failed to induce the reaction between **1a** and **2a** under reflux in dichloromethane. Trifluoromethanesulfonates of scandium(III), tin(II) and ytterbium(III) catalyzed the studied reaction however yield of **4a** varied from low to moderate when these catalysts were used. The best yield of pyrazoline **4a** was achieved when reaction was carried out in the presence of $Ni(ClO_4)_2·6H_2O$ (20 mol%). Nevertheless, with this catalyst the target transformation was accompanied by partial decomposition of diaziridine. To solve this problem, we used portionwise addition of excess of diaziridine **2a**. Using this procedure and 2.5 equiv of **2a** in total, the goal pyrazoline **4a** was obtained in 61% yield.

We studied the scope of this transformation under the optimized reaction conditions varying donor substituent in D–A cyclopropanes **1**. Diaziridine **2a** was transformed into 1-substituted pyrazolines **4** in reaction with all studied cyclopropanes **1** (Scheme 2).



Scheme 2. Scope of reaction of cyclopropanes **1** with diaziridine **2a**. General reaction conditions: 0.05 M solution of **1**, portionwise addition of **2a** (1.25–3 equiv.), molecular sieves 4Å, CH_2Cl_2, reflux. Yields of isolated products are given. [a] Cyclopropane conversion was 61%; brsm yield = 61%.

Structures of pyrazolines **4** were determined on the basis of analysis of their 1D and 2D NMR spectra and unambiguously

proved by single-crystal X-ray data for compound **4h**.[21] This is the first example of X-ray data for 1-alkylpyrazolines bearing no other substituents.[22]

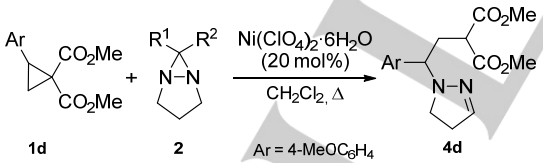
The yield of pyrazolines **4** was found to be dependent on the electron-donating ability of the cation-stabilizing group in D–A cyclopropane. Cyclopropane-1,1-diesters with electron-rich 2-thienyl, 2-furyl, 4-methoxyphenyl, 3,4-dimethoxyphenyl and 2,3,4-trimethoxyphenyl groups afforded the target products **4d-f,h-j** in 65-79% yield while substrates with electroneutral aromatic group **1a,b,l** produced the corresponding pyrazolines **4** in moderate yields (57–63%). Cyclopropane **1c** with electron-depleted 4- fluorophenyl substituent afforded pyrazolines **4c** in 46% yield only. This tendency can be explained by Lewis acid-induced side reactions of **2a** such as its dimerization[20,23] and partial decomposition; the contribution of side reactions increases with the decrease of D–A cyclopropane reactivity.

Although 3,4,5-trimethoxyphenyl substituent is usually considered as an efficient donor, the moderate yield of **4g** is consistent with the aforementioned trend. Indeed, positive mesomeric effect of 4-methoxy group cannot be realized in this compound as this group is oriented perpendicular to the benzene ring due to the repulsion from the adjacent substituents.[24] As a result, cyclopropane **1g** is less reactive than **1d** or **1e**[25] and the contribution of side reactions of diaziridine is quite significant.

At the first glance, the formation of **4m** in 60% yield only is inconsistent with the aforementioned trend as 4-methoxystyryl-substituted cyclopropane **1m** demonstrated excellent reactivity earlier in various processes.[26] Presumably, vinylcyclopropane-to-cyclopentene isomerization[26,27] competes with the studied process for this substrate, providing the decrease of the yield of **4m**. The moderate conversion of **1k** is unclear now.

Then we varied diaziridine derivatives to determine the effect of their structures on the efficiency of the reaction with D–A cyclopropane **1d** selected as model substrate due to its high reactivity against diaziridine **2a** (Table 2).

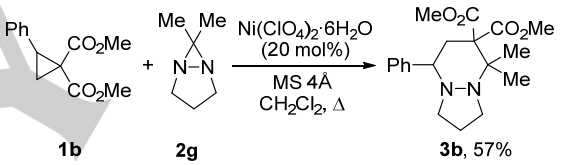
Table 2. Variation of substituents at the C(6) atom in diazabicyclohexanes **2**.[a]



Entry	2	R^1	R^2	Yield of **4d**, %
1	**a**	-$(CH_2)_5$-		70
2	**b**	-$(CH_2)_4$-		66
3	**c**	-$(CH_2)_6$-		28[b]
4	**d**	C_2H_5	C_2H_5	55
5	**e**	C_2H_5	CH_3	57
6	**f**	C_2H_5	H	44
7	**g**	CH_3	CH_3	18[c]

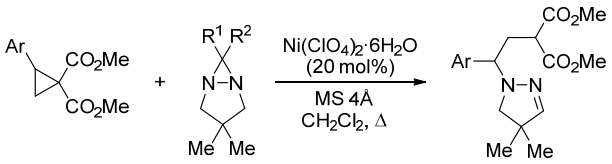
[a] General reaction conditions: 0.05 M solution of **1d**, portionwise addition of **2** (1.8–3 equiv.), molecular sieves 4Å, CH_2Cl_2, reflux. Yields of isolated product are given. [b] Cyclopropane conversion was 39%; brsm yield = 72%. [c] Product of (3+3)-annulation **3a** was also obtained in 43% yield.

It was found that spiro-cyclopentane derivative **2b** is equipotent to compound **2a** while the corresponding cycloheptane analogue **2c** afforded the target pyrazoline **4d** in 28% only. The large steric demands of seven-membered ring are presumably responsible for the lower reactivity of **2c** and, as a result, for the drop of the yield of **4d**. 6,6-Diethyl-substituted 1,5-diazabicyclo[3.1.0]hexane **2d** produced pyrazoline **4d** in lower yield than diaziridine **2a**. This result can be also explained by larger steric demands of two ethyl groups in comparison with the cyclohexane moiety. This is similar to higher nucleophilicity of piperidine *vs.* diethylamine in reactions with diverse electrophiles.[28] A similar yield of pyrazolines **4d** was obtained in the reaction of 6-ethyl-6-methyl analogue **2e** and monosubstituted 6-ethyl derivative **2f**. The latter was highly unexpected as earlier both 6-aryl-1,5-diazabicyclo[3.1.0]hexanes and 1,2,3-triethyldiaziridine in the reaction with D–A cyclopropanes produced only products of (3+3)-annulation.[20] Oppositely, 6,6-dimethyl-substituted diazabicyclohexane **2g** afforded pyrazoline **4d** in 18% yield only; the major product of its reaction with **1d** was (3+3)-cycloadduct **3a**. At last, product of (3+3)-annulation **3b** was exclusively obtained in the reaction of **2g** with 2-phenylcyclopropane-1,1-diester **1b** (Scheme 3).



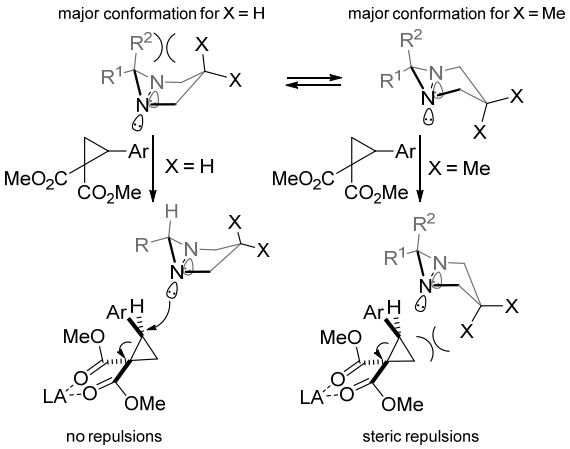
Scheme 3. (3+3)-Annulation of D–A cyclopropane **1b** with diaziridines **2g**.

The variation of substituents at the C(3) atom in 1,5-diazabicyclo[3.1.0]hexanes **2** did not alter the direction of their reaction with D–A cyclopropanes but decreased significantly the yield of pyrazoline **4**. Namely, the introduction of two methyl groups at the C(3) atom of 1,5-diazabicyclo[3.1.0]hexanes decreased significantly their reactivity against D–A cyclopropanes having no effect on the reaction chemoselectivity. As a result, pyrazolines **4n,o** were obtained in very low yield due to small conversion of starting compounds (Scheme 4).



Scheme 4. Reaction of D–A cyclopropanes **1** with diaziridines **2h,i**. [a] Cyclopropane conversion was 16%; brsm yield = 75%. [b] Cyclopropane conversion was 25%; brsm yield = 76%.

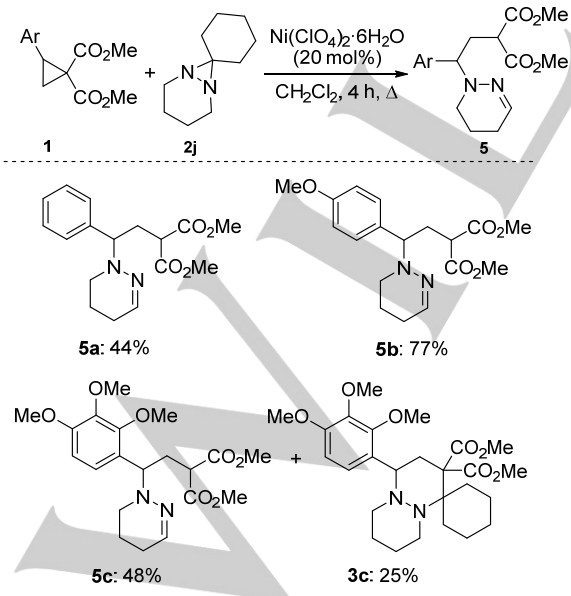
The low reactivity of diaziridines **2h,i** can be explained within this approach by change of their conformation from pseudo-boat to pseudo-chair due to the repulsion between two flagpole substituents. However, axial methyl group in pseudo-chair conformation prevents approach of D–A cyclopropane to nitrogen atom(s) (Scheme 5).



Scheme 5. Deceleration of reactions of **2h,i** in comparison with **2a-g**.

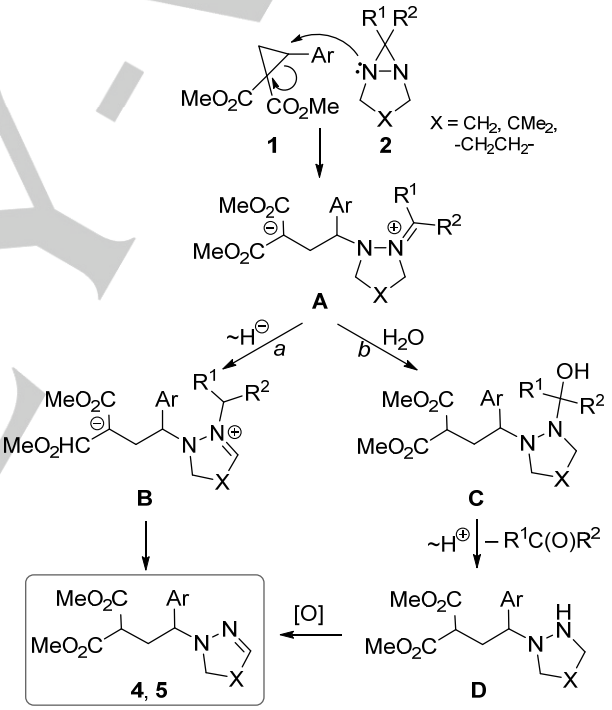
On the other hand, 1,6-diazabicyclo[4.1.0]heptane **2j** which is a homologue of **2a**, reacted with D–A cyclopropanes **1** in a similar efficiency providing 1,4,5,6-tetrahydropyridazines **5** which can be used for the synthesis of piperazic aicd derivatives[13,29] including total synthesis of piperazimycin A[30] and polyoxypeptins A and B.[31]

It is noteworthy that cyclopropanes **1b,d** in this reaction afforded exclusively tetrahydropyridazines **5** while cyclopropane **1h** yielded both **5c** and (3+3)-cycloadduct **3c** (Scheme 6).



Scheme 6. Scope of the reaction of cyclopropanes **1** with diaziridine **2j**. General reaction conditions: 0.05 M solution of **1**, portionwise addition of **2j** (1.8–3 equiv.), molecular sieves 4Å, CH_2Cl_2, reflux. Yields of isolated products are given.

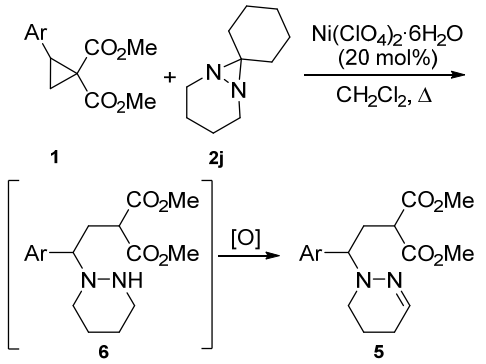
The first step in the formation of compounds **4** and **5** is presumably the alkylation of **2** with Lewis acid-activated cyclopropane **1**. There are two ways for the further transformation of the formed 1,6-zwitterion **A** (Scheme 7). The first one (path *a*) is a 1,3-hydride shift leading to the endocyclic iminium ion **B** followed by the loss of alkyl group (as an alkene or alcohol) producing a cyclic hydrazone.[32] The second one (path *b*) is the hydration of **A** with water molecule from nickel perchlorate hexahydrate affording hemiaminal **C** which eliminates a carbonyl compound yielding 1-alkylated saturated heterocycle **D**. Its oxidation by air oxygen accomplishes the formation of the target product **4** (**5**).



Scheme 7. Two possible mechanisms for the formation of compounds **4** and **5**.

The formation of pyrazolines **4** and tetrahydropyridazines **5** only in the presence of water as well as the reported isolation of pyrazolines in the reaction of primary hydrazines with 1,3-dihalides in alkaline aqueous medium[33] support the realization of path *b* but cannot be considered as unambiguous proof of the mechanism. To better understand this process, we performed GC-MS investigation of the reaction mixture formed in the reaction between **1d** and **2a** and found that it contained cyclohexanone as side product. Moreover, we found that the reaction of D–A cyclopropanes **1** with diaziridine **2j** produced initially hexahydropyridazines **6** that were further oxidized to

products **5** (Scheme 8). All attempts to isolate these side products being unsuccessful due to the aforementioned oxidation.[21] All the obtained data are consistent with the realization of pathway *b* including hydration of zwitterionic intermediate **A** but not with pathway *a* including hydride shift in the above intermediate.



Scheme 8. Formtation of compounds **5** *via* the intermediate formation of hexahydropyridazines **6** followed by their oxidation with air oxygen.

Conclusions

Thus, we have shown that the $Ni(ClO_4)_2·6H_2O$-catalyzed reaction of donor-acceptor cyclopropanes, containing aryl, hetaryl or alkenyl group as a donor, with 1,5-diazabicyclo[3.1.0]hexanes bearing bulky alkyl substituents at the C(6) atom affords the corresponding 1-alkyl-2,3-dihydropyrazoles. Moreover, it was demonstrated that the corresponding 1,6-diazabicyclo[4.1.0]heptanes react similarly producing the corresponding 1,4,5,6-tetrahydropyridazine derivatives. Approaches to the related monosubstituted cyclic hydrazones are very restricted and usually characterized by low yields. Bicyclic diaziridines behave here as synthetic equivalents of difficultly accessible unsubstituted 2,3-dihydropyrazole and unstable 1,4,5,6-tetrahydropyridazine. The discussed reaction proceeds via the alkylation of diaziridine derivative with a Lewis acid-activated cyclopropane followed by hydration of the formed 1,6-zwitterion producing hemiaminal. The elimination of carbonyl compound and air oxidation of the formed pyrazolidine accomplishes the synthesis of title products. The process chemoselectivity was found to depend on the nature of substituents at the carbon atom of the diaziridine ring and donor-acceptor cyclopropane applied.

Experimental Section

1. General information: NMR spectra were recorded on Bruker AM-300, Bruker Avance 400 and Bruker Avance 500 spectrometers at room temperature; the chemical shifts δ were measured in ppm with respect to solvent ($CDCl_3$: ^1H: δ = 7.26 ppm, ^{13}C: δ = 77.0 ppm). Splitting patterns are designated as s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet; dd, double doublet and br (broad). Coupling constants (*J*) are given in Hz. The structures of synthesized compounds were elucidated with the aid of 1D NMR (^1H, ^{13}C) and 2D NMR (COSY ^1H-^1H, HSQC and HMBC ^1H-^{13}C, HMBC ^1H-^{15}N, NOESY ^1H-^1H) spectroscopies. The IR spectra were recorded on InfraLUM FT-801 and Bruker "Alpha" spectrometers in the range 400-4000 cm^{-1} (resolution 2 cm^{-1}). High resolution mass spectra were recorded on a Bruker microTOF-Q™ spectrometer with electrospray ionization (ESI). All measurements were performed in a positive (+MS) ion mode (interface capillary voltage: 4500 V) with scan range *m/z*: 50-3000. External calibration of the mass spectrometer was performed with Electrospray Calibrant Solution (Fluka). A direct syringe injection was used for all analyzed solutions in MeCN (flow rate: 3 µL min^{-1}). Nitrogen was used as nebulizer gas (0.4 bar) and dry gas (4.0 L min^{-1}); interface temperature was set at 180 °C. All spectra were processed by using Bruker DataAnalysis 4.0 software package. GS-MS studies were performed using ACQUITY UPC² equipment with ACQUITY UPC² QDA mass detector; Positive Scan 40.00-400.00 Da, Centroid, CV=15. Column: Viridis® HSS C18 SB 3.0 mm x 150 mm, 1/pkg, Waters; eluent: CO_2/acetonitrile (90:10, v/v), 35 °C, 160 bar, elution rate = 0.6 mL/min. Analytical thin-layer chromatography (TLC) was carried out using Silufol UV 254 TLC silica gel 60 F_{254} aluminum plates and Macherey Nagel ALUGRAM Xtra SIL G UV254. The visualization of the TLC plates was done by UV lamp (365 nm) or by spraying of the plates with 5% alcoholic solution of diphenylamine followed by heating of plates. Melting points (mp) were determined using Electrothermal 9100 and SMP-20 capillary melting point apparatus. X-ray diffraction studies were performed using Bruker SMART Apex II diffractometer (MoKα radiation, graphite monochromator, ω-scans, 120K). Using Olex2[34], structure was solved by the direct method and refined using anisotropic full-matrix approximation against F^2_{hkl}. Column chromatography was performed on silica gel 60 (230-400 mesh, Merck or Macherey-Nagel). All the reactions were carried out using freshly distilled and dry solvents from solvent stills. Cyclopropanes **1** were prepared by Knoevenagel/Corey-Chaykovsky reactions sequence from the corresponding aldehydes.[35,36] Cyclopropanes **1a-k,m** are known compounds but cyclopropanes **1f,g** were not fully characterized previously. 6,6-Dimethyl-1,5-diazabicyclo[3.1.0]hexane **2g** was synthesized according to the published procedure.[37] Spectral data and boiling point are in full accordance with the published ones.[37,38]

2. Synthesis and characterization of donor-acceptor cyclopropanes 1f,g,l.

2.1. Dimethyl 2-[4-(dimethylamino)phenyl]cyclopropane-1,1-dicarboxylate (1f): The 60% suspension of NaH in mineral oil (399 mg, 10.0 mmol) and trimethylsulfoxonium iodide (2.30 g, 10.4 mmol) were added to dry DMSO (20 mL) under argon and stirred for 0.5 h. The mixture was cooled to 10 °C and solution of dimethyl 2-[4-(dimethylamino)benzylidene]malonate (2.50 g, 9.5 mmol) in DMSO (8 mL) was added. After stirring for 1 h at room temperature, the reaction was quenched with ice-cold aqueous NH_4Cl, and extracted with diethyl ether (4×20 mL). The combined organic layer was washed with water (5×10 mL), brine and dried over anhydrous Na_2SO_4. Concentration under reduced pressure afforded an orange oil, which was purified by silica gel chromatography (petroleum ether/EtOAc = 3:1) to afford compound **1f**. Yield 1.9 g (59%), pale-yellow solid; R_f = 0.55 (petroleum ether/EtOAc 4:1); mp = 59–60 °C; ^1H NMR (500 MHz, $CDCl_3$): δ = 1.72 (dd, ^2J = 5.2 Hz, ^3J = 9.3 Hz, 1 H, CH_2), 2.17 (dd, ^2J = 5.2 Hz, ^3J = 8.1 Hz, 1 H, CH_2), 2.94 (s, 6 H, 2×CH_3), 3.18 (dd, ^3J = 9.3 Hz, ^3J = 8.1 Hz, 1 H, CH), 3.42 (s, 3 H, CH_3), 3.80 (s, 3 H, CH_3), 6.65 (d, ^3J = 8.5 Hz, 2 H, Ar), 7.07 (d, ^3J = 8.5 Hz, 2 H, Ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ = 18.8 (CH_2), 32.2 (CH), 36.6 (C), 40.0 (2×CH_3N), 51.6 (CH_3O), 52.1 (CH_3O), 111.7 (2×CH), 121.4 (C), 128.7 (2×CH), 149.3 (C), 166.8 (*C*O_2Me), 170.0 (*C*O_2Me); HRMS (ESI-TOF): *m/z* calcd for $C_{15}H_{20}NO_4^+$: 278.1388 $[M+H]^+$; found: 278.1387; elemental analysis calcd (%) for $C_{15}H_{19}NO_4$: C 64.97, H 6.91, N 5.05; found: C 65.09, H 6.89, N 4.88.

2.2. Dimethyl 2-(3,4,5-trimethoxyphenyl)cyclopropane-1,1-dicarboxylate (1g): The 60% suspension of NaH in mineral oil (868 mg, 21.7 mmol) and trimethylsulfoxonium iodide (5.00 g, 22.7 mmol) were added to dry DMSO (40 mL) under argon and stirred for 0.5 h. The mixture was cooled to 10 ℃ and dimethyl 2-(3,4,5-trimethoxybenzylidene)malonate (6.41 g, 20.7 mmol) in DMSO (15 mL) was added. After stirring for 1.5 h at room temperature, the reaction was quenched with ice-cold aqueous NH_4Cl, and extracted with Et_2O (4×30 mL). The combined organic layer was washed with water (5×20 mL), brine and dried over anhydrous Na_2SO_4. Concentration under reduced pressure afforded a cream residue, which was purified by recrystallization from isopropyl alcohol to afford compound **1g**. Yield 4.9 g (73%), colorless crystals; R_f = 0.37 (petroleum ether/EtOAc 4:1); mp = 77–78 ℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.69 (dd, ^2J = 5.2 Hz, ^3J = 9.3 Hz, 1 H, CH_2), 2.11 (dd, ^2J = 5.2 Hz, ^3J = 8.1 Hz, 1 H, CH_2), 3.15 (dd, ^3J = 9.3 Hz, ^3J = 8.1 Hz, 1 H, CH), 3.42 (s, 3 H, CH_3), 3.76 (s, 3 H, CH_3), 3.78 (s, 3 H, CH_3), 3.80 (s, 6 H, 2×CH_3), 6.39 (s, 2 H, Ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ = 19.6 (CH_2), 32.8 (CH), 37.2 (C), 52.4 (CH_3O), 52.8 (CH_3O), 56.1 (2×CH_3O), 60.8 (CH_3O), 105.6 (2×CH), 130.3 (C), 137.5 (C), 153.0 (2×C), 167.1 (*C*O_2Me), 170.2 (*C*O_2Me); HRMS (ESI-TOF): *m/z* calcd for $C_{16}H_{21}O_7^+$: 325.1277 $[M+H]^+$; found: 325.1282; elemental analysis calcd (%) for $C_{16}H_{20}O_7$: C 59.25, H 6.22; found: C 59.36, H 5.89.

2.3. Dimethyl 2-(1-benzyl-1*H*-indol-4-yl)cyclopropane-1,1-dicarboxylate (1l): The 60% suspension of NaH in mineral oil (701 mg, 17.5 mmol) and trimethylsulfoxonium iodide (4.05 g, 18.4 mmol) were added to dry DMSO (30 mL) under argon and stirred for 0.5 h. The mixture was cooled to 10 ℃ and solution of dimethyl 2-(1-benzyl-1*H*-indol-4-yl)methylidenemalonate[39] (6.13 g, 17.5 mmol) in DMSO (5 mL) was added. After stirring for 3 h at room temperature, the reaction was quenched with ice-cold aqueous NH_4Cl, and extracted with diethyl ether (4×30 mL). The combined organic layer was washed with water (5×20 mL), brine and dried over anhydrous Na_2SO_4. Concentration under reduced pressure afforded a yellow residue, which was purified by silica gel chromatography (petroleum ether/EtOAc = 3:1) to afford compound **1l**. Yield 3.8 g (61%), yellow paste; R_f = 0.63 (petroleum ether/EtOAc 3:1); ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.87 (dd, ^2J = 4.9 Hz, ^3J = 9.3 Hz, 1 H, CH_2), 2.43 (dd, ^2J = 4.9 Hz, ^3J = 8.1 Hz, 1 H, CH_2), 3.26 (s, 3 H, CH_3), 3.62 (dd, ^3J = 9.3 Hz, ^3J = 8.1 Hz, 1 H, CH), 3.88 (s, 3 H, CH_3), 5.33 (s, 2 H, CH_2), 6.75 (br. d, ^3J = 3.2 Hz, 1 H, CH), 6.89–6.90 (m, 1 H, Ar), 7.10–7.13 (m, 3 H, Ar), 7.19 (br. d, ^3J = 3.2 Hz, 1 H, CH), 7.22–7.24 (m, 1 H, Ar), 7.28–7.33 (m, 3 H, Ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ = 19.1 (CH_2), 30.8 (CH), 36.8 (C), 50.2 (CH_2), 51.9 (CH_3O), 52.8 (CH_3O), 100.4 (CH), 109.2 (CH), 118.0 (CH), 121.4 (CH), 126.7 (2×CH), 126.8 (C), 127.6 (CH), 129.3 (CH), 128.7 (2×CH), 129.5 (C), 136.0 (C), 137.6 (C), 167.4 (*C*O_2Me), 170.6 (*C*O_2Me); IR (Nujol): ν = 3400, 2990, 1740, 1520, 1500, 1440, 1325, 1300, 1290, 1010 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{22}H_{22}NO_4^+$ 364.1543 $[M+H]^+$; found 364.1543; elemental analysis calcd (%) for $C_{22}H_{21}NO_4$: C 72.71, H 5.82, N 3.85; found: C 72.89, H 5.89, N 3.88.

3. General procedure 1 for the synthesis of 1,5-diazabicyclo[3.1.0]-hexanes and 1,6-diazabicyclo[4.1.0]heptane (2a-j): Solution of *t*-BuOCl (2.39 g, 22 mmol) in MeOH (3 mL) was added dropwise to the magnetically stirred solution of α,ω-diaminoalkane (40 mmol) in MeOH (30 mL) at –5-0 ºC. Then solution of corresponding ketone or aldehyde (20 mmol) in MeOH (4–6 mL) was added and the reaction mixture was stirred for 24 h at 0–5 ºC. The solid formed was filtered off, the solvent was evaporated under reduced pressure and $CHCl_3$ (60 mL) was added to the residue. The precipitate was filtered off, the solution was washed with water (50 mL), dried with K_2CO_3 and the solvent was evaporated. Compounds were purified by distillation under reduced pressure. Spectral data of the known compounds are consistent well with the described ones.

3.1. 1,5-Diazaspiro(bicyclo[3.1.0]hexane-6,1'-cyclohexane) (2a) was synthesized according to the **General procedure 1** from cyclohexanone (1.96 g, 20 mmol) and 1,3-diaminopropane (2.97 g, 40 mmol). Yield 1.98 g (65%); colorless liquid; R_f = 0.48 ($CHCl_3$/MeOH 10:1); bp = 75 °C/1 Torr (lit. 86–87 °C/1 Torr[40]); ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 1.26–1.41 (m, 6 H, 3×CH_2), 1.41–1.64 (m, 4 H, 2×CH_2), 2.00–2.16 (m, 1 H, C(3)H$_{ax}$), 2.30–2.47 (m, 1 H, C(3)H$_{eq}$), 2.70–2.82 (m, 2 H, C(2)H$_{ax}$, C(4)H$_{ax}$), 3.10–3.24 (m, 2 H, C(2)H$_{eq}$, C(4)H$_{eq}$); ^{13}C NMR ($CDCl_3$, 75 MHz): δ = 24.2, 24.7, 24.9, 25.8, 35.4, 38.3, 47.6 (2 C), 65.7; IR (thin layer): ν = 3405, 2929, 2885, 2855, 1481, 1448, 1382, 1301, 1249, 1220, 1196, 1123, 1019, 985, 963 cm^{-1}; MS (70 eV): *m/z* (%): 152 (67) $[M]^+$, 151 (100) $[(M–H)]^+$, 124 (31) $[(M–2×CH_2)]^+$, 123 (98) $[(M–2×CH_2–H)]^+$, 111 (18) $[(M–3×CH_2–H)]^+$, 98 (9) $[(M–4×CH_2)]^+$; HRMS (ESI-TOF): *m/z* calcd for $C_9H_{17}N_2^+$: 153.1386 $[M+H]^+$; found: 153.1387.

3.2. 1,5-Diazaspiro(bicyclo[3.1.0]hexane-6,1'-cyclopentane) (2b) was synthesized according to the **General procedure 1** from cyclopentanone (1.68 g, 20 mmol) and 1,3-diaminopropane (2.97 g, 40 mmol). Yield 1.47 g (53%); colorless liquid; R_f = 0.43 ($CHCl_3$/MeOH 10:1); bp = 65 °C/1 Torr; ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 1.32–1.40 (m, 2 H, CH_2), 1.49–1.65 (m, 3 H, CH_2), 1.68–1.81 (m, 4 H, CH_2, C(3)H$_{ax}$), 1.85–1.98 (m, 1 H, C(3)H$_{eq}$), 2.87–2.96 (m, 2 H, C(2)H$_{ax}$, C(4)H$_{ax}$), 3.08–3.19 (m, 2 H, C(2)H$_{eq}$, C(4)H$_{eq}$); ^{13}C NMR ($CDCl_3$, 75 MHz): δ = 23.4, 24.5, 26.4, 28.8, 38.1, 49.2 (2 C), 70.9; IR (thin layer): ν = 3397, 3274, 2955, 2876, 1643, 1454, 1436, 1356, 1330, 1287, 1267, 1192, 990, 980 cm^{-1}; HRMS (ESI – TOF): *m/z* calcd for $C_8H_{15}N_2^+$: 139.1230 $[M+H]^+$; found: 139.1235.

3.3. 1,5-Diazaspiro(bicyclo[3.1.0]hexane-6,1'-cycloheptane) (2c) was synthesized according to the **General procedure 1** from cycloheptanone (2.24 g, 20 mmol) and 1,3-diaminopropane (2.97 g, 40 mmol). Yield 1.93 g (58%); colorless liquid; R_f = 0.49 ($CHCl_3$/MeOH 10:1); bp = 89–91 °C/1 Torr; ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 1.43–1.50 (m, 2 H, CH_2), 1.50–1.65 (m, 8 H, 4×CH_2), 1.65–1.75 (m, 2 H, CH_2), 1.75–1.90 (m, 1 H, C(3)H$_{ax}$), 2.10–2.25 (m, 1 H, C(3)H$_{eq}$), 2.81–2.91 (m, 2 H, C(2)H$_{ax}$, C(4)H$_{ax}$), 3.16–3.30 (m, 2 H, C(2)H$_{eq}$, C(4)H$_{eq}$); ^{13}C NMR ($CDCl_3$, 75 MHz): δ = 24.1, 24.8, 25.3, 29.7, 29.9, 32.5, 40.0, 47.9 (2 C), 66.6; IR (thin layer): ν = 3385, 2926, 3854, 1644, 1458, 1384, 1285, 1270, 1189, 1148, 1078, 1018, 994, 953, 900 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{10}H_{19}N_2^+$: 167.1543 $[M+H]^+$; found: 167.1543.

3.4. 6,6-Diethyl-1,5-diazabicyclo[3.1.0]hexane (2d) was synthesized according to the **General procedure 1** from pentan-3-one (1.72 g, 20 mmol) and 1,3-diaminopropane (2.97 g, 40 mmol). Yield 1.41 g (51%); colorless liquid; R_f = 0.38 ($CHCl_3$/MeOH 10:1); bp = 62–63 °C/1 Torr; ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 0.87 (t, $^3J_{H,H}$ = 7.5 Hz, 3 H, CH_3), 1.06 (t, $^3J_{H,H}$ = 7.5 Hz, 3 H, CH_3), 1.39 (q, $^3J_{H,H}$ = 7.5 Hz, 2 H, CH_2), 1.45 (q, $^3J_{H,H}$ = 7.5 Hz, 2 H, CH_2), 2.02–2.20 (m, 1 H, C(3)H$_{ax}$), 2.30–2.48 (m, 1 H, C(3)H$_{eq}$), 2.71–2.85 (m, 2 H, C(2)H$_{ax}$, C(4)H$_{ax}$), 3.12–3.28 (m, 2 H, C(2)H$_{eq}$, C(4)H$_{eq}$); ^{13}C NMR ($CDCl_3$, 75 MHz): δ = 8.4, 9.3, 17.0, 29.6, 35.0, 47.6 (2 C), 67.9; IR (thin layer): ν = 3424, 2968, 2838, 2886, 1729, 1647, 1461, 1382, 1288, 1221, 1104, 1084, 1014, 984, 966 cm^{-1}; HRMS (ESI –TOF): *m/z* calcd for $C_8H_{17}N_2^+$: 141.1386 $[M+H]^+$; found: 141.1381.

3.5. 6-Ethyl-6-methyl-1,5-diazabicyclo[3.1.0]hexane (2e) was synthesized according to the **General procedure 1** from butan-2-one (1.44 g, 20 mmol) and 1,3-diaminopropane (2.97 g, 40 mmol). The diaziridine **2e** was formed as a mixture of *syn*- and *anti*-isomers in 2:1 ratio; yield 1.31 g (52%); colorless liquid; R_f = 0.39 ($CHCl_3$/MeOH 10:1); bp = 47–48 °C/1 Torr.

syn-Isomer: ^{1}H NMR ($CDCl_3$, 400 MHz): δ = 0.86 (t, $^3J_{H,H}$ = 7.5 Hz, 3 H, C(9)H$_3$), 1.04 (s, 3 H, C(7)H$_3$), 1.36 (q, $^3J_{H,H}$ = 7.5 Hz, 2 H, C(8)H$_2$), 1.78–1.91 (m, 1 H, C(3)H$_{ax}$), 2.10–2.23 (m, 1 H, C(3)H$_{eq}$), 2.70–2.80 (m, 2 H, C(2)H$_{ax}$, C(4)H$_{ax}$), 3.10–3.20 (m, 2 H, C(2)H$_{eq}$, C(4)H$_{eq}$); ^{13}C NMR ($CDCl_3$, 100 MHz): δ = 8.6 (C(9)), 9.6 (C(7)), 32.9 (C(3)), 34.3 (C(8)), 48.0 (C(2), C(4)), 64.3 (C(6)).

***anti-Isomer*:** ^{1}H NMR ($CDCl_3$, 400 MHz): δ = 1.02 (t, $^3J_{H,H}$ = 7.5 Hz, 3 H, C(9)H_3), 1.15 (s, 3 H, C(7)H_3), 1.36 (q, $^3J_{H,H}$ = 7.5 Hz, 2 H, C(8)H_2), 1.98–2.08 (m, 1 H, C(3)H_{ax}), 2.25–2.37 (m, 1 H, C(3)H_{eq}), 2.70–2.80 (m, 2 H, C(2)H_{ax}, C(4)H_{ax}), 3.10–3.20 (m, 2 H, C(2)H_{eq}, C(4)H_{eq}); ^{13}C NMR ($CDCl_3$, 100 MHz): δ = 10.5 (C(9)), 20.3 (C(8)), 24.3 (C(7), 34.6 (C(3)), 47.5 (C(2), C(4)), 64.7 (C(6)).
IR (thin layer): ν = 3406, 2968, 2938, 2885, 1370, 1644, 1462, 1382, 1356, 1305, 1261, 1119, 1105, 1078, 1004, 943 cm^{-1}; HRMS (ESI–TOF): *m*/*z* calcd for $C_7H_{15}N_2^+$: 127.1230 $[M+H]^+$; found: 127.1227.

3.6. *anti*-6-Ethyl-1,5-diazabicyclo[3.1.0]hexane (2f) was synthesized according to the **General procedure 1** from propanal (1.16 g, 20 mmol) and 1,3-diaminopropane (2.97 g, 40 mmol). Yield 1.43 g (65%); colorless liquid; R_f = 0.44 ($CHCl_3$/MeOH 10:1); bp = 76 °C/10 Torr; ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 0.88 (t, $^3J_{H,H}$ = 7.5 Hz, 3 H, CH_3), 1.32–1.44 (m, 2 H, CH_2), 1.57–1.80 (m, 2H, C(3)H_2), 2.14 (t, $^3J_{H,H}$ = 5.4 Hz, 1H, C(6)H), 2.81–2.97 (m, 2 H, C(2)H_{ax}, C(4)H_{ax}), 3.21–3.32 (m, 2 H, C(2)H_{eq}, C(4)H_{eq}); ^{13}C NMR ($CDCl_3$, 75 MHz): δ = 9.2, 22.2, 25.3, 51.4 (2 C), 58.2; IR (thin layer): ν = 3418, 2968, 2938, 2877, 1731, 1645, 1463, 1456, 1416, 1377, 1290, 1266, 1241, 1211, 1191, 1178, 1134, 1078, 1032, 963, 917, 900 cm^{-1}; HRMS (ESI-TOF): *m*/*z* calcd for $C_6H_{13}N_2^+$: 113.1073 $[M+H]^+$; found: 113.1070.

3.7. 3,3-Dimethyl-1,5-diazaspiro(bicyclo[3.1.0]hexane-6,1'-cyclohexane) (2h) was synthesized according to the **General procedure 1** from cyclohexanone (1.96 g, 20 mmol) and 2,2-dimethyl-1,3-diaminopropane (4.08 g, 40 mmol). Yield 1.91 g (53%); colorless liquid; R_f = 0.40 ($CHCl_3$/MeOH 10:1); bp = 88–90 °C/1 Torr; ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 1.05 (s, 3 H, CH_3), 1.32 (s, 3 H, CH_3), 1.35–1.45 (m, 2 H, CH_2), 1.45–1.55 (m, 2 H, CH_2), 1.55–1.65 (m, 6 H, 3×CH_2), 2.37 (d, $^2J_{H,H}$ = 10.4 Hz, 2 H, C(2)H_{ax}, C(4)H_{ax}), 2.77 (d, $^2J_{H,H}$ = 10.4 Hz, 2 H, C(2)H_{eq}, C(4)H_{eq}); ^{13}C NMR ($CDCl_3$, 75 MHz): δ = 23.1, 24.0, 24.1, 24.2, 25.8, 29.7, 38.4, 57.3, 58.8 (2 C), 70.4; IR (thin layer): ν = 3393, 2955, 2928, 2856, 1732, 1646, 1465, 1448, 1384, 1271, 1195, 1139, 1114, 1052, 954, 904 cm^{-1}; HRMS (ESI-TOF): *m*/*z* calcd for $C_{11}H_{20}NaN_2^+$: 203.1519 $[M+Na]^+$; found: 203.1516.

3.8. 6-Ethyl-3,3-dimethyl-1,5-diazabicyclo[3.1.0]hexane (2i) was synthesized according to the **General procedure 1** from propanal (1.16 g, 20 mmol) and 2,2-dimethyl-1,3-diaminopropane (4.08 g, 40 mmol). Yield 1.71 g (61%); colorless liquid; R_f = 0.55 ($CHCl_3$/MeOH 10:1); bp = 45 °C/0.5 Torr; ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 0.95 (t, $^3J_{H,H}$ = 7.5 Hz, 3 H, CH_3), 1.10 (s, 3 H, CH_3), 1.24 (s, 3 H, CH_3), 1.38–1.50 (m, 2 H, CH_2), 1.51 (t, $^3J_{H,H}$ = 5.4 Hz, 1 H, CH), 2.65 (d, $^2J_{H,H}$ = 10.3 Hz, 2 H, C(2)H_{ax}, C(4)$H_{ax,}$), 3.04 (d, $^2J_{H,H}$ = 10.3 Hz, 2 H, C(2)H_{eq}, C(4)H_{eq}); ^{13}C NMR ($CDCl_3$, 75 MHz): δ = 9.1, 26.7, 26.9, 29.2, 52.9, 67.5 (2 C), 78.5; IR (thin layer): ν = 3420, 2961, 2936, 2872, 2361, 2342, 1128, 1646, 1464, 1411, 1385, 1368, 1286, 1198, 1122, 1075, 1038, 1005, 947, 903 cm^{-1}; HRMS (ESI-TOF): *m*/*z* calcd for $C_8H_{17}N_2^+$: 141.1386 $[M+H]^+$; found: 141.1390.

3.9. 1,6-Diazaspiro(bicyclo[4.1.0]heptane-7,1'-cyclohexane) (2j) was synthesized according to the **General procedure 1** from cyclohexanone (1.96 g, 20 mmol) and 1,4-diaminobutane (3.53 g, 40 mmol). Yield 1.16 g (35%); colorless liquid; R_f = 0.41 ($CHCl_3$/MeOH 10:1); bp = 86–88 °C/1 Torr (lit. 66 °C/15 Torr[41]); ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 1.35–1.45 (m, 2 H, CH_2), 1.45–1.70 (m, 8 H, 4×CH_2), 1.70–1.85 (m, 4 H, 2×CH_2), 2.45–2.60 (m, 2 H, C(2)H_{ax}, C(5)H_{ax}), 3.03–3.12 (m, 2 H, C(2)H_{eq}, C(5)H_{eq}); ^{13}C NMR ($CDCl_3$, 75 MHz): δ = 17.3 (2 C), 23.6, 24.2, 24.7, 26.0, 38.8, 39.5 (2 C), 63.4; IR (thin layer): ν = 3355, 2934, 3857, 1658, 1448, 1388, 1314, 1247, 1184, 1122, 1077, 1014, 951, 905 cm^{-1}; MS (70 eV): *m*/*z* (%): 166 (47) $[M]^+$, 165 (30) $[M–H]^+$, 151 (13) $[M–CH_2–H]^+$, 137 (52) $[M–2×CH_2–H]^+$, 123 (22) $[M–3×CH_2–H]^+$, 110 (39) $[M–4×CH_2]^+$, 96 (20) $[M–5×CH_2]^+$, 81 (43) $[M–6×CH_2–H]^+$, 70 (46) $[(CH_2)_5]^+$, 41 (97) [N–N–CH]$^+$, 97], 28 (100) $[N_2]^+$; HRMS (ESI-TOF): *m*/*z* calcd for $C_{10}H_{18}NaN_2^+$: 189.1362 $[M+Na]^+$; found: 189.1368.

4. General procedure 2 for the synthesis of pyrazolines 4, 5 and bicyclic hydrazines 3: Cyclopropane **1** (0.5–2 mmol) was dissolved in CH_2Cl_2 to make 0.05 M solution; then $Ni(ClO_4)_2{\cdot}6H_2O$ (20 mol%) and molecular sieves 4 Å was added. The mixture was heated to reflux and a solution of diaziridine **2** (2–3 equiv.) in CH_2Cl_2 (4–5 mL) was added portionwise within 2–3 h (0.25 equiv every 15 minutes). The reaction mixture was stirred under reflux for the time indicated (TLC control). The reaction mixture was cooled to ambient temperature, diluted with CH_2Cl_2 and quenched with 0.5 M aqueous solution of disodium EDTA. The organic layer was washed with 0.5 M solution of disodium EDTA (4–5 times), brine and dried with anhydrous Na_2SO_4. After evaporation of solvent under reduced pressure, the residue was purified by column chromatography on silica gel (SiO_2, eluent – petroleum ether : ethyl acetate, 10:1 to 1:1) to afford target product.

4.1. Dimethyl 8-(4-methoxyphenyl)-5,5-dimethyltetrahydro-1*H*-pyrazolo[1,2-*a*]pyridazine-6,6(5*H*)-dicarboxylate (3a) was obtained together with pyrazoline **4a** (18% yield) from cyclopropane **1d** (150 mg, 0.57 mmol) and diaziridine **2g** (159 mg, 1.42 mmol) after 4 h according to the **General procedure 2**. Yield 92 mg (43%); cream solid; R_f = 0.40 (petroleum ether/EtOAc 5:1); mp = 95–96 °C; ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 1.36 (s, 3 H, CH_3), 1.55 (s, 3 H, CH_3), 1.69–1.87 (m, 2 H, CH_2), 2.10–2.19 (m, 1 H, CH_2), 2.28–2.36 (m, 2 H, CH_2), 2.67–2.73 (m, 1 H, CH_2), 2.76–2.82 (m, 1 H, CH_2), 2.97–3.04 (m, 1 H, CH_2), 3.51 (dd, $^3J_{H,H}$ = 10.2 Hz, $^3J_{H,H}$ = 5.4 Hz, 1 H, CH), 3.68 (s, 3 H, CH_3O), 3.75 (s, 3 H, CH_3O), 3.80 (s, 3 H, CH_3O), 6.86 (d, $^3J_{H,H}$ = 8.6 Hz, 2 H, Ar), 7.32 (d, $^3J_{H,H}$ = 8.6 Hz, 2 H, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 14.7 (CH_3), 21.9 (CH_3), 25.0 (CH_2), 37.9 (CH_2), 45.2 (C), 52.0 (CH_3O), 52.3 (CH_3O), 53.5 (CH_2), 55.3 (CH_3O), 60.4 (CH_2), 61.3 (C), 66.9 (CH), 113.8 (2×CH, Ar), 128.6 (2×CH, Ar), 135.3 (C, Ar), 159.0 (C, Ar), 170.3 (*C*O$_2$Me), 170.6 (*C*O$_2$Me); IR (KBr) 2963, 2835, 1740, 1735, 1610, 1585, 1510, 1455, 1435, 1365, 1245, 1175, 1100, 1070, 1040, 915 cm^{-1}; HRMS (ESI-TOF): *m*/*z* calcd for $C_{20}H_{29}N_2O_5^+$: 377.2071 $[M+H]^+$; found: 377.2063; elemental analysis calcd (%) for $C_{20}H_{28}N_2O_5$: C 63.81, H 7.50, N 7.44; found: C 63.58, H 7.48, N 7.26.

4.2. Dimethyl 5,5-dimethyl-8-phenyltetrahydro-1*H*-pyrazolo[1,2-*a*]pyridazine-6,6(5*H*)-dicarboxylate (3b) was obtained from cyclopropane **1b** (115 mg, 0.45 mmol) and diaziridine **2g** (110 mg, 0.98 mmol) after 4 h according to the **General procedure 2**. Yield 97 mg (57%); yellow oil; R_f = 0.52 (petroleum ether/EtOAc 5:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 1.38 (s, 3 H, CH_3), 1.57 (s, 3 H, CH_3), 1.70–1.79 (m, 1 H, CH_2), 1.82–1.89 (m, 1 H, CH_2), 2.13–2.18 (m, 1 H, CH_2), 2.33–2.37 (m, 2 H, CH_2), 2.72 (ddd, $^2J_{H,H}$ = 10.4 Hz, $^3J_{H,H}$ = 8.9 Hz, $^3J_{H,H}$ = 7.1 Hz, 1 H, CH_2), 2.80–2.84 (m, 1 H, CH_2), 2.99–3.04 (m, 1 H, CH_2), 3.58 (dd, $^3J_{H,H}$ = 9.9 Hz, $^3J_{H,H}$ = 5.8 Hz, 1 H, CH), 3.69 (s, 3 H, CH_3O), 3.77 (s, 3 H, CH_3O), 7.25–7.28 (m, 1 H, Ph), 7.31–7.34 (m, 2 H, Ph), 7.41–7.42 (m, 2 H, Ph); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 14.7 (CH_3), 22.0 (CH_3), 25.0 (CH_2), 37.9 (CH_2), 45.1 (C), 52.1 (CH_3O), 52.3 (CH_3O), 53.5 (CH_2), 60.4 (CH_2), 61.3 (C), 67.7 (CH), 127.5 (CH, Ph), 127.6 (2×CH, Ph), 128.5 (2×CH, Ph), 143.1 (C, Ph), 170.3 (*C*O$_2$Me), 170.6 (*C*O$_2$Me); IR (KBr) 3025, 2975, 2955, 2840, 1750, 1735, 1605, 1495, 1455, 1435, 1365, 1240, 1195, 1175, 1100, 1065, 1005, 915 cm^{-1}; HRMS (ESI-TOF): *m*/*z* calcd for $C_{19}H_{27}N_2O_4^+$: 347.1965 $[M+H]^+$; found: 347.1960.

4.3. Dimethyl 4'-(2,3,4-trimethoxyphenyl)hexahydro-2'*H*-spiro[cyclohexane-1,1'-pyridazino[1,2-a]pyridazine]-2',2'-dicarboxylate (3c). Yield 83 mg (25%); colorless oil; R_f = 0.41 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 1.06–1.12 (m, 1 H, CH_2), 1.19–1.26 (m, 1 H, CH_2), 1.40–1.47 (m, 3 H, CH_2), 151–1.55 (m, 2 H, CH_2), 1.64–1.69 (m, 2 H, CH_2), 1.77–1.95 (m, 4 H, CH_2), 2.28 (dd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 2.9 Hz, 1 H, CH_2), 2.33–2.35 (m, 1 H, CH_2), 2.61 (dd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 12.2 Hz, 1 H, CH_2), 2.56–2.61 (m, 1 H, CH_2), 2.70–2.76 (m, 1 H, CH_2), 2.92–2.97 (m, 1 H, CH_2), 3.04–3.10 (m, 1 H, CH_2), 3.66 (s, 3 H, CH_3O), 3.75 (s, 3 H, CH_3O), 3.86 (s, 3 H, CH_3O), 3.89 (s, 3 H, CH_3O), 3.90 (s, 3 H, CH_3O), 4.99 (dd, $^3J_{H,H}$ = 12.2 Hz, $^3J_{H,H}$ = 2.9 Hz, 1 H, CH), 6.72 (d,

$^3J_{H,H}$ = 8.7 Hz, 1 H, CH, Ar), 7.19 (d, $^3J_{H,H}$ = 8.7 Hz, 1 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 18.9 (CH_2), 21.6 (CH_2), 22.0 (CH_2), 26.45 (CH_2), 26.47 (CH_2), 30.0 (CH_2), 32.5 (CH_2), 37.3 (C), 38.2 (CH_2), 42.9 (CH), 49.5 (CH_2), 52.4 (CH_3O), 52.5 (CH_3O), 56.2 (CH_3O), 59.0 (C), 61.0 (CH_3O), 61.9 (CH_3O), 63.9 (CH), 108.4 (CH, Ar), 123.2 (CH, Ar), 128.9 (C, Ar), 142.2 (C, Ar), 152.2 (C, Ar), 152.3 (C, Ar), 170.9 (*C*O_2Me), 171.8 (*C*O_2Me); IR (KBr): ν = 2920, 2850, 1752, 1735, 1720, 1600, 1495, 1465, 1350, 1285, 1225, 1170, 1100, 1020, 970, 910 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{26}H_{38}KN_2O_7^+$: 529.2311 [M+K]$^+$; found: 529.2314.

4.4. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-(*p*-tolyl)ethyl]malonate (4a) was obtained from cyclopropane **1a** (150 mg, 0.60 mmol) and diaziridine **2a** (230 mg, 1.50 mmol) after 5 h according to the **General procedure 2**. Yield 116 mg (61%); beige oil; R_f = 0.47 (EtOAc/petroleum ether 1:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.32 (s, 3 H, CH_3), 2.43–2.56 (m, 1H, C(3)H_2 + 2 H, C(4')H_2), 2.75–2.82 (m, 1 H, C(5')H_2), 2.84–2.94 (m, 2 H, C(5')H_2 + C(3)H_2), 3.55 (dd, $^3J_{H,H}$ = 7.8 Hz, $^3J_{H,H}$ = 6.9 Hz, 1 H, C(2)H), 3.68 (s, 3 H, CH_3O), 3.72 (s, 3 H, CH_3O), 3.91–3.96 (m, 1 H, C(4)H), 6.75 (br. s, 1 H, C3'), 7.11–7.14 (m, 2 H, C(3'')H + C(5'')H, Ar), 7.15–7.18 (m, 2 H, C(2'')H + C(6'')H, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 21.2 (CH_3), 33.5 (C(4')H_2), 33.7 (C(3)H_2), 49.4 (C(2)H), 49.7 (C(5')H_2), 52.6 (2×CH_3O), 65.6 (C(4)H), 128.7 (C(2'')H, C(6'')H), 129.1 (C(3'')H, C(5'')H), 135.8 (C(1'')), 137.5 (C(4'')), 143.4 (C(3')H), 170.0 (*C*O_2Me), 170.1 (*C*O_2Me); IR (KBr): ν = 2955, 2845, 1750, 1735, 1435, 1285, 1265, 1230, 1155, 1020, 935 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{17}H_{22}N_2NaO_4^+$: 341.1472 [M+Na]$^+$; found: 341.1480; elemental analysis calcd (%) for $C_{17}H_{22}N_2O_4$: C 64.13, H 6.97, N 8.80; found: C 63.84, H 7.16, N 8.49.

4.5. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-phenylethyl]malonate (4b) was obtained from cyclopropane **1b** (115 mg, 0.49 mmol) and diaziridine **2a** (224 mg, 1.47 mmol) after 8 h according to the **General procedure 2**. Yield 94 mg (63%); beige oil; R_f = 0.52 (EtOAc/petroleum ether 1:1); ^{1}H NMR ($CDCl_3$, 500 MHz) δ = 2.48–2.60 (m, 3 H, CH_2), 2.79–2.84 (m, 1 H, CH_2), 2.87–2.97 (m, 2 H, CH_2), 3.60 (t, $^3J_{H,H}$ = 7.3 Hz, 1 H, CH), 3.70 (s, 3 H, CH_3O), 3.74 (s, 3 H, CH_3O), 3.99 (t, $^3J_{H,H}$ = 7.5 Hz, 1 H, CH), 6.77 (br. s, 1 H, CH=N), 7.28–7.35 (m, 5 H, Ph); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 33.6 (CH_2), 33.7 (CH_2), 49.4 (CH), 49.8 (CH_2), 52.6 (2×CH_3O), 65.9 (CH), 127.9 (CH, Ph), 128.4 (2×CH, Ph), 128.8 (2×CH, Ph), 138.9 (C, Ph), 142.5 (CH=N), 169.9 (*C*O_2Me), 170.1 (*C*O_2Me); IR (KBr): ν = 2955, 2845, 1750, 1735, 1435, 1285, 1265, 1230, 1155, 1020, 935 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{16}H_{21}N_2O_4^+$: 305.1496 [M+H]$^+$; found: 305.1501.

4.6. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-(4-fluorophenyl)-ethyl]malonate (4c) was obtained from cyclopropane **1c** (190 mg, 0.75 mmol) and diaziridine **2a** (229 mg, 1.50 mmol) after 5 h according to the **General procedure 2**. Yield 111 mg (46%); colorless oil; R_f = 0.59 (EtOAc/petroleum ether 1:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.40–2.46 (m, 1 H, CH_2), 2.47–2.55 (m, 2 H, CH_2), 2.69–2.75 (m, 1 H, CH_2), 2.82–2.89 (m, 2 H, CH_2), 3.55 (t, $^3J_{H,H}$ = 7.4 Hz, 1 H, CH), 3.67 (s, 3 H, CH_3O), 3.70 (s, 3 H, CH_3O), 3.94 (t, $^3J_{H,H}$ = 7.5 Hz, 1 H, CH), 6.70–6.71 (m, 1 H, CH=N), 6.98 (dd, ^3J = 8.7 Hz, $^3J_{H,F}$ = 8.7 Hz, 2 H, CH, Ar), 7.23 (dd, ^3J = 8.7 Hz, $^4J_{H,F}$ = 5.5 Hz, 2 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 33.4 (CH_2), 33.7 (CH_2), 49.2 (CH), 49.7 (CH_2), 52.5 (2×CH_3O), 65.0 (CH), 115.2 (d, $^2J_{C,F}$ = 21 Hz, 2×CH, Ar), 130.3 (d, $^3J_{C,F}$ = 8 Hz, 2×CH, Ar), 134.8 (d, $^4J_{C,F}$ = 3 Hz, C, Ar), 143.0 (CH=N), 162.3 (d, $^1J_{C,F}$ = 246 Hz, C, Ar), 169.8 (*C*O_2Me), 169.9 (*C*O_2Me); IR (KBr): ν = 3120, 3030, 2955, 2845, 1750, 1735, 1605, 1510, 1405, 1270, 1160, 1015 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{16}H_{19}FN_2NaO_4^+$: 345.1221 [M+Na]$^+$; found: 345.1223; elemental analysis calcd (%) for $C_{16}H_{19}FN_2O_4$: C 59.62, H 5.94, N 8.69; found: C 59.72, H 5.66, N 8.64

4.7. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-(4-methoxyphenyl)ethyl]malonate (4d) was obtained from cyclopropane **1d** (120 mg, 0.45 mmol) and diaziridine **2a** (173 mg, 1.13 mmol) after 4 h according to the **General procedure 2**. Yield 105 mg (70%); colorless oil; R_f = 0.28 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.38–2.53 (m, 3 H, CH_2), 2.70–2.78 (m, 1 H, CH_2), 2.78–2.90 (m, 2 H, CH_2), 3.52 (t, $^3J_{H,H}$ = 7.3 Hz, 1 H, CH), 3.65 (s, 3 H, CH_3O), 3.69 (s, 3 H, CH_3O), 3.75 (s, 3 H, CH_3O), 3.88 (t, $^3J_{H,H}$ = 7.3 Hz, 1 H, CH), 6.69 (br. s, 1 H, CH=N), 6.82 (br. d, ^3J = 7.4 Hz, 2 H, CH, Ar), 7.16 (br. d, $^3J_{H,H}$ = 7.4 Hz, 2 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 33.3 (CH_2), 33.7 (CH_2), 49.3 (CH), 49.6 (CH_2), 52.4 (2×CH_3O), 55.2 (CH_3O), 65.1 (CH), 113.6 (2×CH, Ar), 129.7 (2×CH, Ar), 130.9 (C, Ar), 142.8 (CH=N), 159.1 (C, Ar), 169.9 (*C*O_2Me), 170.0 (*C*O_2Me); IR (KBr): ν = 3125, 3010, 2955, 2930, 2850, 1735, 1610, 1510, 1405, 1385, 1275, 1115, 1030, 935 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{17}H_{22}N_2NaO_5^+$: 357.1421 [M+Na]$^+$; found: 357.1420; elemental analysis calcd (%) for $C_{17}H_{22}N_2O_5 \cdot 0.5H_2O$: C 59.46, H 6.75, N 8.16; found: C 59.88, H 7.02, N 8.02.

4.8. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-(3,4-dimethoxyphenyl)ethyl]malonate (4e) was obtained from cyclopropane **1e** (110 mg, 0.37 mmol) and diaziridine **2a** (114 mg, 0.75 mmol) after 3 h according to the **General procedure 2**. Yield 88 mg (65%); beige oil; R_f = 0.18 (petroleum ether/EtOAc 4:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.40–2.46 (m, 1 H, CH_2), 2.47–2.51 (m, 2 H, CH_2), 2.74–2.79 (m, 1 H, CH_2), 2.83–2.89 (m, 2 H, CH_2), 3.54 (t, $^3J_{H,H}$ = 7.4 Hz, 1 H), 3.66 (s, 3 H, CH_3O), 3.70 (s, 3 H, CH_3O), 3.83 (s, 3 H, CH_3O), 3.84 (s, 3 H, CH_3O), 3.87 (t, $^3J_{H,H}$ = 7.4 Hz, 1 H, CH), 6.72 (br. s, 1 H, CH=N), 6.76 (dd, $^3J_{H,H}$ = 8.3 Hz, $^4J_{H,H}$ = 1.5 Hz, 1 H, CH, Ar), 6.78 (d, $^3J_{H,H}$ = 8.3 Hz, 1 H, CH, Ar), 6.82 (d, $^4J_{H,H}$ = 1.5 Hz, 1 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 33.4 (CH_2), 33.8 (CH_2), 49.2 (CH), 49.6 (CH_2), 52.4 (2×CH_3O), 55.8 (CH_3O), 55.9 (CH_3O), 65.5 (CH), 110.7 (CH), 111.4 (CH), 121.0 (CH), 131.5 (C), 142.8 (CH=N), 148.5 (C), 148.9 (C), 169.8 (*C*O_2Me), 170.0 (*C*O_2Me); IR (KBr): ν = 3120, 3000, 2955, 2840, 1750, 1735, 1590, 1515, 1435, 1260, 1235, 1150 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{18}H_{25}N_2O_6^+$: 365.1707 [M+H]$^+$; found: 365.1702; elemental analysis calcd (%) for $C_{18}H_{24}N_2O_6 \cdot H_2O$: C 56.54, H 6.85, N 7.33; found: C 56.74, H 6.62, N 7.06.

4.9. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-(4-dimethylaminophenyl)ethyl]malonate (4f) was obtained from cyclopropane **1f** (190 mg, 0.69 mmol) and diaziridine **2a** (209 mg, 1.37 mmol) after 4 h according to the **General procedure 2**. Yield 158 mg (66%); colorless oil, darkens on standing; R_f = 0.51 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.44–2.53 (m, 3 H, CH_2), 2.79–2.95 (m, 3 H, CH_2), 2.94 (s, 6 H, $N(CH_3)_2$), 3.58 (t, $^3J_{H,H}$ = 7.3 Hz, 1 H, CH), 3.69 (s, 3 H, CH_3O), 3.77 (s, 3 H, CH_3O), 3.90 (t, $^3J_{H,H}$ = 7.5 Hz, 1 H, CH), 6.68 (d, $^3J_{H,H}$ = 8.5 Hz, 2 H, Ar), 6.73 (br. s, 1 H, CH=N), 7.14 (d, $^3J_{H,H}$ = 8.5 Hz, 2 H, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 33.4 (CH_2), 33.7 (CH_2), 40.6 (2×N*C*H_3), 49.5 (CH), 49.6 (CH_2), 52.45 (CH_3O), 52.46 (CH_3O), 65.2 (CH), 112.3 (2×CH), 126.5 (C), 129.5 (2×CH), 142.6 (CH), 150.1 (C), 170.0 (*C*O_2Me), 170.2 (*C*O_2Me); IR (KBr) ν = 3100, 3025, 2800, 1750, 1735, 1610, 1525, 1405, 1270, 1155, 1065, 1020, 945 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{18}H_{25}N_3NaO_4^+$: 357.1421 [M+Na]$^+$; found: 357.1420.

4.10. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-(3,4,5-trimethoxyphenyl)ethyl]malonate (4g) was obtained from cyclopropane **1g** (975 mg, 3.00 mmol) and diaziridine **2a** (916 mg, 6.01 mmol) after 3 h according to the **General procedure 2**. Yield 639 mg (54%); light-yellow oil; R_f = 0.32 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.40–2.45 (m, 1 H, CH_2), 2.52–2.56 (m, 2 H, CH_2), 2.78–2.92 (m, 3 H, CH_2), 3.56 (t, $^3J_{H,H}$ = 7.5 Hz, 1 H, CH), 3.68 (s, 3 H, CH_3O), 3.71 (s, 3 H, CH_3O), 3.81 (s, 3 H, CH_3O), 3.82 (s, 6 H, 2×CH_3O), 3.85 (t, $^3J_{H,H}$ = 7.5 Hz, 1 H, CH), 6.49 (s, 2 H, CH, Ar), 6.76 (br. s, 1 H, CH=N); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 33.5 (CH_2), 33.9 (CH_2), 49.2 (CH), 49.8 (CH_2), 52.53 (CH_3O), 52.54 (CH_3O), 56.1 (2×CH_3O), 60.8 (CH_3O), 66.1 (CH), 105.4 (2×CH, Ar), 134.9 (C, Ar), 137.3 (C, Ar), 143.1 (CH=N), 153.1 (2×C, Ar), 169.9 (*C*O_2Me), 170.0 (*C*O_2Me); IR (thin layer): ν = 2995, 2955, 2840, 1750, 1735, 1590, 1505, 1460, 1435, 1425, 1325,

1270, 1240, 1150, 1125, 1045, 1010 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{19}H_{26}N_2NaO_7^+$: 417.1632 [M+Na]$^+$; found: 417.1635.

4.11. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-(2,3,4-trimethoxyphenyl)ethyl]malonate (4h) was obtained from cyclopropane **1h** (111 mg, 0.34 mmol) and diaziridine **2a** (130 mg, 0.86 mmol) after 4 h according to the **General procedure 2**. Yield 103 mg (77%); cream solid; R_f = 0.32 (petroleum ether/EtOAc 2:1); mp = 103–104 °C; ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.35–2.41 (m, 1 H, CH_2), 2.46–2.52 (m, 2 H, CH_2), 2.60–2.67 (m, 1 H, CH_2), 2.84–2.90 (m, 1 H, CH_2), 3.04–3.09 (m, 1 H, CH_2), 3.61 (t, $^3J_{H,H}$ = 7.1 Hz, 1 H, CH), 3.68 (s, 3 H, CH_3O), 3.69 (s, 3 H, CH_3O), 3.82 (s, 3 H, CH_3O), 3.83 (s, 3 H, CH_3O), 3.84 (s, 3 H, CH_3O), 4.39 (t, $^3J_{H,H}$ = 7.5 Hz, 1 H, CH), 6.64 (d, $^3J_{H,H}$ = 8.7 Hz, 1 H, CH, Ar), 6.70 (br. s, 1 H, CH=N), 7.06 (d, $^3J_{H,H}$ = 8.7 Hz, 1 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 33.4 (CH_2), 33.5 (CH_2), 49.3 (CH), 50.3 (CH_2), 52.39 (CH_3O), 52.40 (CH_3O), 55.9 (CH_3O), 56.8 (CH), 60.7 (CH_3O), 61.1 (CH_3O), 107.4 (CH, Ar), 123.4 (CH, Ar), 124.9 (C, Ar), 141.7 (C, Ar), 142.6 (CH=N), 152.4 (C, Ar), 152.8 (C, Ar), 169.96 (*C*O$_2$Me), 170.00 (*C*O$_2$Me); IR (KBr): ν = 3120, 2995, 2955, 2840, 1750, 1735, 1600, 1465, 1435, 1290, 1225, 1155, 1095, 1030 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{19}H_{26}N_2NaO_7^+$: 417.1632 [M+Na]$^+$; found: 417.1631; elemental analysis calcd (%) for $C_{19}H_{26}N_2O_7$: C 57.86, H 6.64, N 7.10; found: C 57.86, H 6.59, N 6.85.

4.12. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-(5-methylthiophen-2-yl)ethyl]malonate (4i) was obtained from cyclopropane **1i** (200 mg, 0.78 mmol) and diaziridine **2a** (196 mg, 1.97 mmol) after 3 h according to the **General procedure 2**. Yield 200 mg (79%); yellow oil; R_f = 0.53 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.43 (d, $^4J_{H,H}$ = 1.1 Hz, 3 H, CH_3), 2.47–2.59 (m, 3 H, CH_2), 2.74–2.80 (m, 1 H, CH_2), 2.84–2.97 (m, 2 H, CH_2), 3.66 (dd, $^3J_{H,H}$ = 7.6 Hz, $^3J_{H,H}$ = 7.0 Hz, 1 H, CH), 3.72 (s, 3 H, CH_3O), 3.73 (s, 3 H, CH_3O), 4.36 (dd, $^3J_{H,H}$ = 8.5 Hz, $^3J_{H,H}$ = 7.0 Hz, 1 H, CH), 6.58 (dd, $^3J_{H,H}$ = 3.4 Hz, $^4J_{H,H}$ = 1.1 Hz, 1 H, CH, Th), 6.67 (d, $^3J_{H,H}$ = 3.4 Hz, 1 H, CH, Th), 6.77–6.78 (m, 1 H, CH=N); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 15.4 (CH_3), 33.6 (CH_2), 34.3 (CH_2), 49.2 (CH_2), 49.2 (CH), 52.5 (CH_3O), 52.6 (CH_3O), 60.6 (CH), 124.3 (CH, Th), 126.6 (CH, Th), 138.9 (C, Th), 140.0 (C, Th), 143.4 (CH=N), 169.8 (*C*O$_2$Me), 170.0 (*C*O$_2$Me); IR (KBr): ν = 3060, 3000, 2955, 2845, 1750, 1735, 1580, 1435, 1345, 1155, 1045, 935 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{15}H_{21}N_2O_4S^+$: 325.1217 [M+H]$^+$; found: 325.1207; elemental analysis calcd (%) for $C_{15}H_{20}N_2O_4S$: C 55.54, H 6.21, N 8.64; found: C 55.27, H 6.15, N 8.45.

4.13. Dimethyl 2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-2-(5-methylfuran-2-yl)ethyl]malonate (4j) was obtained from cyclopropane **1j** (115 mg, 0.48 mmol) and diaziridine **2a** (184 mg, 1.21 mmol) after 5 h according to the **General procedure 2**. Yield 110 mg (74%); light yellow oil; R_f = 0.36 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.23 (d, $^4J_{H,H}$ = 1.1 Hz, 3 H, CH_3), 2.47–2.57 (m, 3 H, CH_2), 2.68 (ddd, $^2J_{H,H}$ = 14.1 Hz, $^3J_{H,H}$ = 8.9 Hz, $^3J_{H,H}$ = 7.3 Hz, 1 H, CH_2), 2.85–2.91 (m, 1 H, CH_2), 2.94–3.00 (m, 1 H, CH_2), 3.66 (t, $^3J_{H,H}$ = 7.3 Hz, 1 H, CH), 3.71 (s, 6 H, 2×CH_3O), 4.25 (dd, $^3J_{H,H}$ = 8.9 Hz, $^3J_{H,H}$ = 6.8 Hz, 1 H, CH), 5.86 (dd, $^3J_{H,H}$ = 3.0 Hz, $^4J_{H,H}$ = 1.1 Hz, 1 H, CH, Fu), 6.05 (d, $^3J_{H,H}$ = 3.0 Hz, 1 H, CH, Fu), 6.73 (br. s, 1 H, CH=N); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 13.7 (CH_3), 31.0 (CH_2), 33.6 (CH_2), 48.2 (CH_2), 49.0 (CH), 52.5 (CH_3O), 52.6 (CH_3O), 58.4 (CH), 106.0 (CH, Fu), 109.4 (CH, Fu), 143.1 (CH=N), 150.7 (C, Fu), 151.8 (C, Fu), 169.7 (*C*O$_2$Me), 169.9 (*C*O$_2$Me); IR (KBr): ν = 3105, 2955, 2845, 1750, 1735, 1555, 1435, 1345, 1310, 1155, 1020, 960, 935 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{15}H_{20}N_2NaO_5^+$: 331.1264 [M+Na]$^+$; found: 331.1272; elemental analysis calcd (%) for $C_{15}H_{20}N_2O_5$: C 58.43, H 6.54, N 9.09; found: C 58.30, H 6.31, N 9.09.

4.14. Dimethyl 2-[2-(benzofuran-2-yl)-2-(4,5-dihydro-1*H*-pyrazol-1-yl)ethyl]malonate (4k) was obtained from cyclopropane **1k** (230 mg, 0.84 mmol) and diaziridine **2a** (319 mg, 2.10 mmol) after 5 h according to the **General procedure 2**. Yield 107 mg (37%); pale-yellow oil; R_f = 0.38 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.57–2.61 (m, 2 H, CH_2), 2.86 (ddd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 7.5 Hz, $^3J_{H,H}$ = 6.4 Hz, 1 H, CH_2), 2.84 (ddd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 8.9 Hz, $^3J_{H,H}$ = 7.0 Hz, 1 H, CH_2), 2.99–3.10 (m, 2H, CH_2), 3.73 (s, 3 H, CH_3O), 3.74 (s, 3 H, CH_3O), 3.76 (dd, $^3J_{H,H}$ = 7.5 Hz, $^3J_{H,H}$ = 7.0 Hz, 1 H, CH), 4.52 (dd, $^3J_{H,H}$ = 8.9 Hz, $^3J_{H,H}$ = 6.4 Hz, 1 H, CH), 6.61 (br. s, 1 H, CH, Ar), 6.77 (br. s, 1 H, CH=N), 7.19–7.28 (m, 2 H, CH, Ar), 7.47 (br. d, $^3J_{H,H}$ = 8.1 Hz, 1 H, CH, Ar), 7.53 (br. d, $^3J_{H,H}$ = 7.6 Hz, 1 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 31.0 (CH_2), 33.8 (CH_2), 48.5 (CH_2), 49.0 (CH), 52.7 (2×CH_3O), 58.8 (CH), 105.5 (CH, Ar), 111.4 (CH, Ar), 121.1 (CH, Ar), 122.8 (CH, Ar), 124.1 (CH, Ar), 128.1 (C, Ar), 143.4 (CH=N), 154.8 (C, Ar), 155.5 (C, Ar), 169.7 (*C*O$_2$Me), 169.9 (*C*O$_2$Me); IR (KBr): ν = 3110, 3030, 2955, 2930, 2845, 1750, 1735, 1580, 1455, 1435, 1275, 1255, 1155, 1060, 1010, 935 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{18}H_{20}N_2NaO_5^+$: 367.1264 [M+Na]$^+$; found: 367.1254; elemental analysis calcd (%) for $C_{18}H_{20}N_2O_5$: C 62.78, H 5.85, N 8.13; found: C 62.69, H 5.87, N 7.98.

4.15. Dimethyl 2-[2-(1-benzyl-1*H*-indol-4-yl)-2-(4,5-dihydro-1*H*-pyrazol-1-yl)ethyl]malonate (4l) was obtained from cyclopropane **1l** (180 mg, 0.50 mmol) and diaziridine **2a** (189 mg, 1.24 mmol) after 4 h according to the **General procedure 2.** Yield 124 mg (57%); colorless oil; R_f = 0.33 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.49–2.57 (m, 2 H, CH_2), 2.68–2.73 (m, 1 H, CH_2), 2.89–2.93 (m, 2 H, CH_2), 3.09–3.15 (m, 1 H, CH_2), 3.63 (t, $^3J_{H,H}$ = 7.3 Hz, 1 H, CH), 3.66 (s, 3 H, CH_3O), 3.71 (s, 3 H, CH_3O), 4.44 (t, $^3J_{H,H}$ = 7.2 Hz, 1 H, CH), 5.32 (s, 2 H, CH_2), 6.74 (d, $^3J_{H,H}$ = 3.3 Hz, 1 H, CH, Ar), 6.79 (br. s, 1 H, CH=N), 7.13–7.18 (m, 4 H, CH, Ar), 7.23–7.25 (m, 1 H, CH, Ar), 7.26–7.34 (m, 4 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 33.5 (CH_2), 33.6 (CH_2), 49.5 (CH), 50.3 (CH_2), 50.5 (CH_2), 52.4 (2×CH_3O), 63.8 (CH), 100.6 (CH, Ar), 109.1 (CH, Ar), 119.0 (CH, Ar), 121.6 (CH, Ar), 127.0 (2×CH, Ar), 127.7 (CH, Ar), 128.1 (CH, Ar), 131.8 (C, Ar), 128.8 (2×CH, Ar), 131.8 (C, Ar), 136.6 (C, Ar), 137.5 (C, Ar), 142.5 (CH=N), 170.0 (*C*O$_2$Me), 170.1 (*C*O$_2$Me); IR (KBr): ν = 3030, 2955, 2845, 1750, 1735, 1605, 1510, 1495, 1435, 1290, 1275, 1155 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{25}H_{27}N_3NaO_4^+$: 456.1894 [M+Na]$^+$; found: 456.1895; elemental analysis calcd (%) for $C_{25}H_{27}N_3O_4 \cdot 0.33\ H_2O$: C 68.32, H 6.35; found: C 68.19, H 6.20.

4.16. Dimethyl (*E*)-2-[2-(4,5-dihydro-1*H*-pyrazol-1-yl)-4-(4-methoxyphenyl)but-3-en-1-yl]malonate (4m) was obtained from cyclopropane **1m** (200 mg, 0.69 mmol) and diaziridine **2a** (262 mg, 1.72 mmol) after 4 h according to the **General procedure 2**. Yield 149 mg (60%); colorless oil; R_f = 0.20 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 2.34–2.40 (m, 1 H, CH_2), 2.57–2.66 (m, 3 H, CH_2), 2.97–3.07 (m, 2H, CH_2), 3.53–3.98 (m, 1 H, CH), 3.69 (s, 3 H, CH_3O), 3.71–3.74 (m, 1 H, CH), 3.73 (s, 3 H, CH_3O), 3.80 (s, 3 H, CH_3O), 5.94 (dd, $^3J_{H,H}$ = 16.0 Hz, $^3J_{H,H}$ = 8.7 Hz, 1 H, CH=), 6.42 (d, $^3J_{H,H}$ = 16.0 Hz, 1 H, CH=), 6.78 (br. s, 1 H, CH=N), 6.85 (br. d, $^3J_{H,H}$ = 8.7 Hz, 2 H, CH, Ar), 7.30 (br. d, $^3J_{H,H}$ = 8.7 Hz, 2 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 32.8 (CH_2), 33.5 (CH_2), 49.0 (CH), 49.3 (CH_2), 52.5 (2×CH_3O), 55.4 (CH_3O), 63.9 (CH), 114.5 (2×CH), 125.4 (CH), 127.7 (2×CH), 129.4 (C), 133.4 (CH), 143.5 (CH), 159.4 (C), 170.0 (*C*O$_2$Me), 170.1 (*C*O$_2$Me); IR (KBr): ν = 3120, 3000, 2955, 2840, 1735, 1610, 1510, 1435, 1270, 1155, 1030, 975 cm^{-1}; HRMS (ESI-TOF) *m/z* calcd for $C_{19}H_{25}N_2O_5^+$: 361.1758 [M+H]$^+$; found: 361.1759; elemental analysis calcd (%) for $C_{19}H_{24}N_2O_5$: C 63.32, H 6.71, N 7.77; found: C 63.31, H 6.62, N 7.62.

4.17. Dimethyl 2-[2-(4,4-dimethyl-4,5-dihydro-1*H*-pyrazol-1-yl)-2-phenylethyl]malonate (4n) was obtained from cyclopropane **1b** (115 mg, 0.44 mmol) and diaziridine **2h** (157 mg, 0.87 mmol) after 4 h according to the **General procedure 2.** Yield 18 mg (12%); beige oil; R_f = 0.49 (petroleum ether/EtOAc 4:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 1.04 (s, 3 H, CH_3), 1.08 (s, 3 H, CH_3), 2.43–2.49 (m, 1 H, CH_2), 2.61 (d, $^2J_{H,H}$ = 9.0 Hz, 1 H, CH_2), 2.65 (d, $^2J_{H,H}$ = 9.0 Hz, 1 H, CH_2), 2.87–2.93 (m, 1 H, CH_2), 3.58 (t, $^3J_{H,H}$ = 7.3 Hz, 1 H, CH), 3.70 (s, 3 H, CH_3O), 3.74 (s, 3 H, CH_3O), 3.93 (t, $^3J_{H,H}$ = 7.4 Hz, 1 H, CH), 6.48 (br. s, 1 H, CH=N), 7.28–7.29 (m, 3

H, Ph), 7.32–7.35 (m, 2 H, Ph); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 24.0 (CH_3), 24.1 (CH_3), 33.7 (CH_2), 46.3 (C), 49.3 (CH), 52.6 (2×CH_3O), 63.9 (CH_2), 65.7 (CH), 127.8 (CH, Ph), 128.4 (2×CH, Ph), 128.6 (2×CH, Ph), 139.3 (C, Ph), 151.4 (CH=N), 170.0 (*C*O_2Me), 170.1 (*C*O_2Me); IR (KBr): ν = 3030, 2955, 2870, 1755, 1740, 1605, 1585, 1495, 1455, 1435, 1265, 1235, 1155, 1065, 1030, 910 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{18}H_{24}KN_2O_4^+$: 371.1368 [M+K]$^+$; found: 371.1365.

4.18. Dimethyl 2-[2-(4,4-dimethyl-4,5-dihydro-1*H*-pyrazol-1-yl)-2-(4-methoxyphenyl)ethyl]malonate (4o) was obtained from cyclopropane **1d** (120 mg, 0.44 mmol) and diaziridine **2h** (159 mg, 1.14 mmol) after 4 h according to the **General procedure 2**. Yield 30 mg (19%); yellow oil; R_f = 0.38 (petroleum ether/EtOAc 4:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 1.04 (s, 3 H, CH_3), 1.07 (s, 3 H, CH_3), 2.40–2.46 (m, 1 H, CH_2), 2.61 (d, $^2J_{H,H}$ = 9.0 Hz, 1 H, CH_2), 2.63 (d, $^2J_{H,H}$ = 9.0 Hz, 1 H, CH_2), 2.84–2.90 (m, 1 H, CH_2), 3.56 (t, $^3J_{H,H}$ = 7.3 Hz, 1 H, CH), 3.69 (s, 3 H, CH_3O), 3.74 (s, 3 H, CH_3O), 3.81 (s, 3 H, CH_3O), 3.89 (t, $^3J_{H,H}$ = 7.5 Hz, Hz, 1 H, CH), 6.46 (br. s, 1 H, CH=N), 6.86 (d, $^3J_{H,H}$ = 8.7 Hz, 2 H, Ar), 7.20 (d, $^3J_{H,H}$ = 8.7 Hz, 2 H, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 24.0 (CH_3), 24.1 (CH_3), 33.7 (CH_2), 46.2 (C), 49.4 (CH), 52.5 (CH_3O), 52.6 (CH_3O), 55.3 (CH_3O), 63.8 (CH_2), 65.1 (CH), 113.7 (2×CH, Ar), 129.7 (2×CH, Ar), 131.3 (C, Ar), 151.3 (CH=N), 159.1 (C, Ar), 170.0 (*C*O_2Me), 170.1 (*C*O_2Me); IR (thin layer) 2955, 2870, 2840, 1755, 1740, 1610, 1585, 1515, 1460, 1435, 1345, 1290, 1250, 1205, 1180, 1160, 1035, 910 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{19}H_{27}N_2O_5^+$: 363.1914 [M+H]$^+$; found: 363.1923; elemental analysis calcd (%) for $C_{19}H_{26}N_2O_5$: C 62.97, H 7.23, N 7.73; found: C 63.21, H 7.53, N 7.54.

4.19. Dimethyl 2-{2-[5,6-dihydropyridazin-1(4*H*)-yl]-2-phenylethyl}-malonate (5a) was obtained from cyclopropane **1b** (145 mg, 0.62 mmol) and diaziridine **2j** (206 mg, 1.24 mmol) after 4 h according to the **General procedure 2.** Yield 87 mg (44%); colorless oil; R_f = 0.20 (petroleum ether/EtOAc 2:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 1.79–1.84 (m, 1 H, CH_2), 1.89–1.97 (m, 1 H, CH_2), 1.99–2.03 (m, 2 H, CH_2), 2.43 (ddd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 7.9 Hz, $^3J_{H,H}$ = 5.9 Hz, 1 H, CH_2), 2.59 (ddd, $^2J_{H,H}$ = 11.0 Hz, $^3J_{H,H}$ = 9.5 Hz, $^3J_{H,H}$ = 3.5 Hz, 1 H, CH_2), 2.68 (ddd, $^2J_{H,H}$ = 11.0 Hz, $^3J_{H,H}$ = 5.7 Hz, $^3J_{H,H}$ = 4.0 Hz, 1 H, CH_2), 2.89 (ddd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 9.8 Hz, $^3J_{H,H}$ = 6.7 Hz, 1 H, CH_2), 3.68 (dd, $^3J_{H,H}$ = 7.9 Hz, $^3J_{H,H}$ = 6.7 Hz, 1 H, CH), 3.73 (s, 3 H, CH_3O), 3.74 (s, 3 H, CH_3O), 4.05 (dd, $^3J_{H,H}$ = 9.8 Hz, $^3J_{H,H}$ = 5.9 Hz, 1 H, CH), 6.67 (br. s, 1 H, CH=N), 7.27–7.34 (m, 5 H, CH, Ph); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 19.9 (CH_2), 23.3 (CH_2), 32.1 (CH_2), 46.3 (CH_2), 49.5 (CH), 52.5 (2×CH_3O), 67.2 (CH), 127.6 (CH, Ph), 128.2 (4×CH, Ph), 138.3 (CH=N), 139.7 (C, Ph), 170.1 (*C*O_2Me), 170.3 (*C*O_2Me); IR (KBr): ν = 2990, 2950, 2850, 1740, 1725, 1605, 1580, 1450, 1425, 1290, 1255, 1120, 1050, 940 cm^{-1}; elemental analysis calcd (%) for $C_{17}H_{22}N_2O_4$: C 63.13, H 6.97, N 8.80; found: C 63.55, H 7.15, N 8.41.

4.20. Dimethyl 2-{2-[5,6-dihydropyridazin-1(4*H*)-yl]-2-(4-methoxyphenyl)ethyl}malonate (5b) was obtained from cyclopropane **1d** (178 mg, 0.68 mmol) and diaziridine **2j** (224 mg, 1.35 mmol) after 4 h according to the **General procedure 2**. Yield 182 mg (77%); colorless oil; R_f = 0.23 (EtOAc/petroleum ether 1:1); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 1.79–1.84 (m, 1 H, CH_2), 1.89–1.97 (m, 1 H, CH_2), 1.99–2.02 (m, 2 H, CH_2), 2.41 (ddd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 7.6 Hz, $^3J_{H,H}$ = 6.1 Hz, 1 H, CH_2), 2.56–2.61 (m, 1 H, CH_2), 2.64–2.68 (m, 1 H, CH_2), 2.85 (ddd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 9.5 Hz, $^3J_{H,H}$ = 6.7 Hz, 1 H, CH_2), 3.65 (dd, $^3J_{H,H}$ = 7.6 Hz, $^3J_{H,H}$ = 6.7 Hz, 1 H, CH), 3.73 (s, 3 H, CH_3O), 3.74 (s, 3 H, CH_3O), 3.81 (s, 3 H, CH_3O), 3.99 (dd, $^3J_{H,H}$ = 9.5 Hz, $^3J_{H,H}$ = 6.1 Hz, 1 H, CH), 6.66 (br. s, 1 H, CH=N), 6.85 (d, $^3J_{H,H}$ = 8.7 Hz, 2 H, CH, Ar), 7.23 (d, $^3J_{H,H}$ = 8.7 Hz, 2 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 19.9 (CH_2), 23.3 (CH_2), 32.1 (CH_2), 46.2 (CH_2), 49.5 (CH), 52.6 (2×CH_3O), 55.3 (CH_3O), 66.6 (CH), 113.5 (2×CH, Ar), 129.3 (2×CH, Ar), 131.6 (C, Ar), 138.5 (CH=N), 159.0 (C, Ar), 170.2 (*C*O_2Me), 170.3 (*C*O_2Me); IR (KBr): ν = 3000, 2955, 2910, 2835, 1750, 1735, 1610, 1585, 1510, 1435, 1325, 1250, 1175, 1155, 1110, 1035, 965, 945 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{18}H_{24}N_2NaO_5^+$: 371.1577 [M+Na]$^+$; found: 371.1578.

4.21. Dimethyl 2-{2-[5,6-dihydropyridazin-1(4*H*)-yl]-2-(2,3,4-trimethoxyphenyl)ethyl}malonate (5c) was obtained from cyclopropane **1h** (220 mg, 0.68 mmol) and diaziridine **2j** (226 mg, 1.36 mmol) after 4 h according to the **General procedure 2** together with product of (3+3)-annulation **3c**. Yield 133 mg (48%); a light-yellow oil; R_f = 0.10 (petroleum ether/EtOAc 1:2); ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 1.76–1.81 (m, 1 H, CH_2), 1.93–2.02 (m, 3 H, CH_2), 2.31 (ddd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 8.2 Hz, $^3J_{H,H}$ = 6.0 Hz, 1 H, CH_2), 2.50–2.55 (m, 1 H, CH_2), 2.85 (ddd, $^2J_{H,H}$ = 14.0 Hz, $^3J_{H,H}$ = 9.6 Hz, $^3J_{H,H}$ = 6.4 Hz, 1 H, CH_2), 2.86–2.90 (m, 1 H, CH_2), 3.67 (dd, $^3J_{H,H}$ = 8.2 Hz, $^3J_{H,H}$ = 6.4 Hz, 1 H, CH), 3.73 (s, 6 H, 2×CH_3O), 3.85 (s, 3 H, CH_3O), 3.87 (s, 6 H, 2×CH_3O), 4.44 (dd, $^3J_{H,H}$ = 9.6 Hz, $^3J_{H,H}$ = 6.0 Hz, 1 H, CH), 6.65 (d, $^3J_{H,H}$ = 8.7 Hz, 1 H, CH, Ar), 6.65 (br. s, 1 H, CH=N), 7.12 (d, $^3J_{H,H}$ = 8.7 Hz, 1 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125 MHz): δ = 19.9 (CH_2), 23.2 (CH_2), 32.2 (CH_2), 47.0 (CH_2), 49.5 (CH), 52.4 (2×CH_3O), 55.9 (CH_3O), 58.2 (CH), 60.7 (CH_3O), 61.3 (CH_3O), 107.2 (CH, Ar), 122.8 (CH, Ar), 125.7 (C, Ar), 138.2 (CH=N), 141.7 (C, Ar), 152.0 (C, Ar), 152.7 (C, Ar), 170.1 (*C*O_2Me), 170.2 (*C*O_2Me); IR (KBr): ν = 2920, 2850, 1750, 1720, 1600, 1490, 1450, 1350, 1290, 1230, 1170, 1100, 1020, 970, 910 cm^{-1}; HRMS (ESI-TOF): *m/z* calcd for $C_{20}H_{28}N_2NaO_7^+$: 431.1789 [M+Na]$^+$; found: 431.1786.

4.22. Dimethyl 2-[2-(tetrahydropyridazin-1(2*H*)-yl)-2-(2,3,4-trimethoxyphenyl)ethyl]malonate (6) was isolated as mixture with **5c** in ratio 87:13; ^{1}H NMR ($CDCl_3$, 500 MHz): δ = 1.06–1.16 (m, 1 H, CH_2), 1.38–1.45 (m, 1 H, CH_2), 1.53–1.79 (m, 3 H, CH_2), 1.98–2.09 (m, 1 H, CH_2), 2.11 (ddd, $^2J_{H,H}$ = 13.8 Hz, $^3J_{H,H}$ = 7.5 Hz, $^3J_{H,H}$ = 6.1 Hz, 1 H, CH_2), 1.98–2.09 (m, 1 H, CH_2), 2.57–2.70 (m, 1 H, CH_2), 2.74 (ddd, $^2J_{H,H}$ = 13.8 Hz, $^3J_{H,H}$ = 9.6 Hz, $^3J_{H,H}$ = 6.6 Hz, 1 H, CH_2), 2.82–2.97 (m, 2H, CH_2), 3.69–3.71 (m, 1 H, CH), 3.69 (s, 3 H, CH_3O), 3.71 (s, 3 H, CH_3O), 3.79 (s, 3 H, CH_3O), 3.84 (s, 3 H, CH_3O), 3.85 (s, 3 H, CH_3O), 4.05 (dd, $^3J_{H,H}$ = 9.7 Hz, $^3J_{H,H}$ = 5.7 Hz, 1 H, CH), 6.65 (d, $^3J_{H,H}$ = 8.7 Hz, 1 H, CH, Ar), 6.97 (d, $^3J_{H,H}$ = 8.7 Hz, 1 H, CH, Ar); ^{13}C NMR ($CDCl_3$, 125MHz): δ = 25.2 (CH_2), 26.5 (CH_2), 31.5 (CH_2), 47.1 (CH_2), 49.7 (CH), 52.4 (CH_3O), 52.5 (CH_3O), 55.2 (CH_2), 56.0 (CH_3O), 58.9 (CH), 60.8 (CH_3O), 61.2 (CH_3O), 106.9 (CH, Ar), 122.9 (C, Ar), 123.4 (CH, Ar), 142.1 (C), 152.8 (C, Ar), 152.9 (C, Ar), 170.3 (*C*O_2Me), 170.6 (*C*O_2Me).

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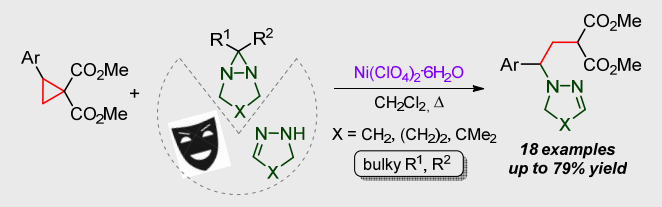

A simple and efficient methodology for the synthesis of 1-alkyl-2,3-dihydropyrazoles and the corresponding tetrahydropyridazines has been proposed. In this process bicyclic diaziridines were used as synthetic equivalent of difficultly accessible unsubstituted 2,3-dihydropyrazole and unstable unsubstituted tetrahydropyridazine.

Nitrogen Heterocycles

A. O. Chagarovskiy, V. V. Kuznetsov, O. A. Ivanova, A. S. Goloveshkin, I. I. Levina, N. N. Makhova, I. V. Trushkov**

Page No. – Page No.

Synthesis of 1-Substituted Pyrazolines by Reaction of Donor-Acceptor Cyclopropanes with 1,5-Diazabicyclo[3.1.0]hexanes