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# One-pot cyclization of dilithiated nitriles with isothiocyanates and epibromohydrin. Synthesis of 2-cyano-1-(hydroxymethyl)-cyclopropanes and 2-cyanomethylidene-4-(hydroxymethyl)-thiazolidines

Uwe Albrecht,[a] Ilia Freifeld,[a] Helmut Reinke[b] and Peter Langer[b,c,*]

[a]*Institut für Chemie und Biochemie, Universität Greifswald, Soldmannstr. 16, 17487 Greifswald, Germany*
[b]*Institut für Chemie, Universität Rostock, Albert-Einstein-Str. 3a, 18059 Rostock, Germany*
[c]*Leibniz-Institut für Katalyse e. V. an der Universität Rostock, Albert-Einstein-Str. 29a, 18059 Rostock, Germany*

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**Abstract**—The cyclization of dilithiated nitriles with epibromohydrin afforded 2-cyano-1-(hydroxymethyl)cyclopropanes. 2-Cyanomethylidene-(4-hydroxymethyl)thiazolidines were prepared by one-pot cyclization of dilithiated nitriles with isothiocyanates and epibromohydrin.


## 1. Introduction

One-pot cyclizations of dianions with dielectrophiles are of considerable synthetic utility.[1] In this context, epibromohydrin (EBH) has been used as a versatile synthetic building block. In recent years, we reported one-pot cyclizations of epibromohydrin with dilithiated 1,3-dicarbonyl compounds,[2] amides,[3] oximes and hydrazones.[4] The Lewis acid mediated cyclization of EBH with 1,3-bis-silyl enol ethers has been reported.[5] 2-Cyano-1-(hydroxymethyl)cyclopropanes are available by cyclization of epihalohydrins with nitriles in the presence of weak or strong bases.[6,7] Recently, we have shown that the sequential addition of isothiocyanates and EBH to dilithiated nitriles provides a convenient approach to 2-cyanomethylidene-(4-hydroxymethyl)thiazolidines.[8] With respect to our preliminary communications in this field,[6,8] we herein report full details of one-pot cyclizations of EBH with nitriles with[8] or without[6] addition of isothiocyanates.

## 2. Results and discussion

### 2.1. Synthesis of 2-cyano-1-(hydroxymethyl)cyclopropanes

The reaction of the dianion[9] of phenylacetonitrile (**1a**), generated by addition of *n*-BuLi (2.3 equiv), with epibromohydrin (**2**, EBH) afforded the 2-cyano-1-(hydroxymethyl)-cyclopropane **3a**.[10,11] Optimal yields (up to 79%) were obtained when (a) lithium perchlorate was added, (b) an excess of the dianion was used (2.5 equiv) and (c) the reaction mixture was stirred for 10 h at −35 °C and subsequently for 8 h at 20 °C (Scheme 1, Table 1). The use of 1-tosyloxy-2, 3-epoxypropane and epichlorohydrin proved to be unsuccessful. Cyclopropane **3a** was isolated as an inseparable diastereomeric mixture (*cis*/*trans*=8:1, the CN and the $CH_2OH$ group are located cis to each other). The presence of Lewis acid proved to be important for the activation of the epoxide in the cyclization step. The tuning of the temperature proved to be important as the first attack of **1a** onto **2** occurred selectively at −35 °C. Upon warming to 20 °C and stirring at this temperature, the cyclization step occurred. Therefore, selectivity and yield decreased when the temperature of the reaction mixture was not maintained at −35 °C for 10 h. The use of an excess of the dianion was important to achieve a complete conversion of **2**.

The formation of **3a** can be explained by attack of the dianion onto the carbon attached to the bromine atom, cyclization and subsequent protonation upon aqueous work-up. Alternatively, attack of the dianion onto the sterically less encumbered carbon atom of the epoxide and subsequent $S_Ni$ reaction is in principle possible. The diastereoselectivity can be explained by steric interaction of the phenyl and the hydroxymethyl group during the cyclization (Scheme 1).

The cyclization of arylacetonitriles **1a–g** with EBH afforded the 2-cyano-1-(hydroxymethyl)cyclopropanes **3a–g** in

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* Corresponding author. Tel.: +49 381 4986410; fax: +49 381 4986412; e-mail: peter.langer@uni-rostock.de

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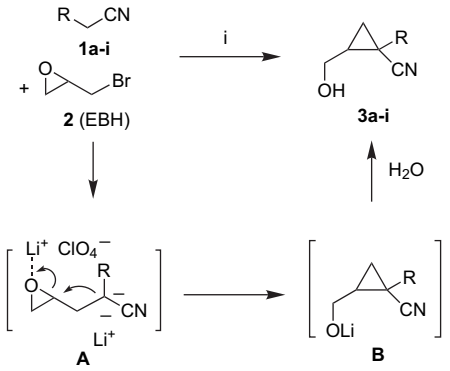



**Scheme 1.** Cyclization of dilithiated arylacetonitriles with epibromohydrin; *i*: (1) 2.3 *n*-BuLi, (2) **2**, $LiClO_4$, THF, (3) $H_2O$.

**Table 1**. Optimization of the reaction of dilithiated **1a** with functionalized epoxides

| Entry |  | Lewis acid (equiv) | **1a** (equiv) | *t* [h][a] | (%)[b] |
|---|---|---|---|---|---|
| 1 | OTos | — | 2.5 | 10+8 | 0 |
| 2 | OTos | $LiClO_4$ (2.5) | 2.5 | 10+8 | 0 |
| 3 | Cl | $LiClO_4$ (2.5) | 2.5 | 10+8 | 36 |
| 4 | Br | — | 1.0 | 10+8 | 22 |
| 5 | Br | — | 2.5 | 10+8 | 30 |
| 6 | Br | LiCl (2.5) | 2.5 | 10+8 | 35 |
| 7 | Br | $LiClO_4$ (2.5) | 2.5 | 10+8 | 79 |
| 8 | Br | $LiClO_4$ (2.5) | 1.0 | 10+8 | 48 |
| 9 | Br | $LiClO_4$ (2.5) | 2.5 | 1+12 | 24 |

[a] Reaction-time at −35 °C + reaction-time at 20 °C.
[b] Isolated yield of non-separable diastereomeric mixtures.

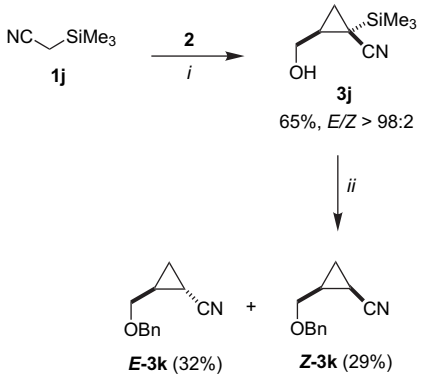
moderate to good yields and with good diastereoselectivity (Scheme 1, Table 2). The reaction of (*N*-methylpyrrol-2-yl)acetonitrile with EBH afforded the cyclopropane **3h**. The cyclopropyl-substituted thiophene **3i** was prepared from (thien-2-yl)acetonitrile; the trans-diastereomer could be isolated in pure form. The yields of **3a–i** were generally good (except for **3f** containing a substituent at the *ortho* position of the aryl group). For all products (except for **3h**, dr=3:1) good diastereoselectivities in favour of the cis configured products were observed (dr=5:1–8:1). The selectivity can be explained by steric interaction of the aryl group with the oxygen atom of the epoxide in intermediate **A** (Scheme 1). An electronic impact on the stereoselectivity cannot be excluded.

**Table 2**. Synthesis of 2-cyano-1-(hydroxymethyl)cyclopropanes **3a–i**

| **3** | R | (%)[a] | *cis*/*trans*[b] |
|---|---|---|---|
| **a** | Ph | 79 | 8:1 |
| **b** | 4-$MeC_6H_4$ | 56 | 7:1 |
| **c** | 4-(MeO)$C_6H_4$ | 52 | 7:1 |
| **d** | 3-$MeC_6H_4$ | 71 | 7:1 |
| **e** | 3-(MeO)$C_6H_4$ | 75 | 6:1 |
| **f** | 2-$MeC_6H_4$ | 34 | 5:1 |
| **g** | 2-Naphthyl | 81 | 5:1 |
| **h** | *N*-Methylpyrrol-2-yl | 83[c] | 3:1 |
| **i** | Thien-2-yl | 39[c] | <2:98[d] |

[a] Isolated yields of non-separable diastereomeric mixtures.
[b] By $^1H$ NMR of the isolated product.
[c] LDA was used.
[d] Besides, a mixture of diastereomers (*cis*/*trans*=1:4) was isolated (43%).

The cyclization of dilithiated (trimethylsilyl)acetonitrile (**1j**) with EBH afforded the TMS-substituted cyclopropane **3j** with excellent diastereoselectivity (Scheme 2).[12,13] Notably, this transformation required the use of freshly prepared **1j**. Treatment of **3j** with TBAF afforded **3k**; however, the yield was low, due to decomposition and volatility of the product. The reaction of **3j** with NaH (2.4 equiv) and benzylic bromide (1.2 equiv) afforded the benzylated TMS-free cyclopropane **3k** as a separable mixture of diastereomers. The formation of **3k** can be explained by benzylation of the hydroxyl group, nucleophilic attack of NaH onto the TMS-group, extrusion of $HSiMe_3$ and formation of a cyclopropyl carbanion, which was protonated during the aqueous work-up. The use of 2 equiv (rather than only one) of NaH proved to be important. The configuration of cyclopropanes **3a**, **3j**, *cis*-**3k** and *trans*-**3k** was proved by NOESY experiments.



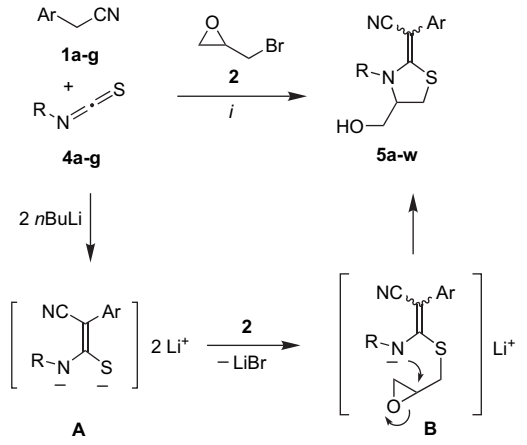

**Scheme 2.** Cyclization of dilithiated (trimethylsilyl)acetonitrile with epibromohydrin; *i*: (1) 2.3 LDA, (2) **2**, $LiClO_4$, THF, (3) $H_2O$; *ii*: BnBr (1.2 equiv), NaH (2.4 equiv), THF, 20 °C, 48 h.

## 2.2. Synthesis of 2-cyanomethylidene-(4-hydroxymethyl)thiazolidines

One-pot cyclizations often rely on the addition of a nucleophile onto a relais species (e.g., a nitrile or cumulene) and subsequent cyclization with a dielectrophile. Isothiocyanates represent interesting relais species in this type of transformation.[14] For example, one-pot cyclizations of arylmethylnitriles (dinucleophile) with isothiocyanates (relais species) and 1,2-dibromoethane, chloroacetic chloride[15] or ethyl 2-chloro-2-oxoacetate (dielectrophile) have been reported.[16] Recently, we have found that the reaction of the dianion of arylacetonitriles with isothiocyanates and epibromohydrin (EBH) afforded 2-alkylidene-(4-hydroxymethyl)thiazolidines.[8] Notably, (4-hydroxymethyl)thiazolidines and -oxazolidines are present in a variety of pharmacologically relevant compounds.[17] Related compounds have been employed as building blocks in the synthesis of penicillinic derivatives, D-biotin and allokainic acid.[18] Previous syntheses of (4-hydroxymethyl)thiazolidines and -oxazolidines rely on cyclization reactions with direct formation of the hydroxymethyl group. This includes, for example, cyclizations of aziridines with carbon disulfide,[19] hydrolysis of 4-thioxo-2-azetidinones[20] or cyclizations of ketenethioacetals with 1,3-propanedioles.[21] Other syntheses are based on the reduction of carboxylic derivatives and include, for example, condensations of aldehydes or ketones with L-cysteine,[22a,b] cyclizations of L-serinal derivatives,[23] cyclizations of potassium

malonate with isothiocyanatoacrylates[24] or hydrogenations of 2-vinylthiazetidines followed by rearrangement.[25]

The reaction of the dianion of phenylacetonitrile (**1a**) with *N*-phenylisothiocyanate (**4a**) and EBH afforded the 2-alkylidene-(4-hydroxymethyl)thiazolidine **5a** in up to 82% yield (Scheme 3).[8] During the optimization, the use of epibromohydrin proved to be mandatory; the employment of epichlorohydrin was unsuccessful. The following parameters also played an important role: (a) the sequential addition of the starting materials, (b) the temperature (0 °C rather than −78 °C) and (c) the generation of a dianion[9] by using a strong base (*n*-BuLi); employment of a weak base (NaH or $K_2CO_3$, THF, reflux) and a sequential deprotonation process proved to be unsuccessful. The formation of **5a** presumably proceeds by attack of the dianion onto the central carbon atom of **4a** to give intermediate **A**, attack of the sulfur atom onto **2** and subsequent cyclization. The reaction of **A** with **2** can proceed by initial attack of the sulfur atom of **A** onto the bromide group and subsequent cyclization via the epoxide or, alternatively, by attack onto the epoxide, Payne rearrangement and subsequent cyclization. The cyclization proceeded with very good regioselectivity and with good *E*-diastereoselectivity (*E*/*Z*=5:1), due to steric repulsion of the phenyl groups. The *S*-regioselectivity is a result of the higher nucleophilicity of sulfur compared to nitrogen.




**Scheme 3.** Synthesis of 2-alkylidenethiazolidines **5a**–**w**, *i*: (a) *n*-BuLi (2.2 equiv), 1 h, 0 °C, (b) **4a**–**g**, 1 h, 0 °C, (c) **2**, 16 h, 0→20 °C.

The reaction of arylmethylnitriles **1a**–**g** with **4a**–**g** and EBH afforded the thiazolidines **5a**–**w** (Scheme 3, Table 3). All products were formed in moderate to good to very good yields, with very good regioselectivity and with good *E*/*Z*-diastereoselectivity (except for **5f**). The *E*/*Z*-diastereoselectivity can be presumably explained by steric interaction between the aryl group and the substituent R; however, an electronic impact on the stereoselectivity cannot be excluded. The low yield of **5f** can be explained by competing metal/bromide exchange.

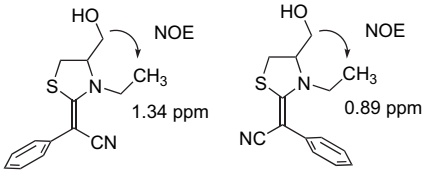
The structure of the products was established by spectroscopic methods (NOESY, COSY, DEPT). For example, a NOESY interaction was observed between the $CH_3$ and the $CH_2OH$ group of **5l**, which indicates that the latter is located next to the *N*-ethyl group. The *Z*-configuration of the exocyclic double bond of the major isomer is supported

**Table 3**. Products and yields

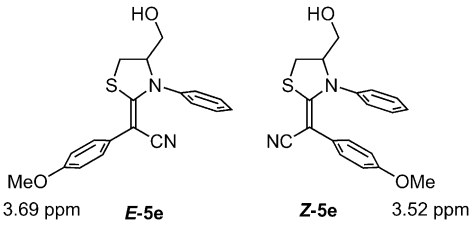
| 5 | Ar | R | % (5)[a] | *Z*/*E*[b] |
|---|---|---|---|---|
| **a** | Ph | Ph | 82 | 1:5 |
| **b** | 4-$MeC_6H_4$ | Ph | 86 | 1:3 |
| **c** | 4-(MeO)$C_6H_4$ | Ph | 94 | 1:2 |
| **d** | 2-$MeC_6H_4$ | Ph | 75 | 1:2 |
| **e** | 2-(MeO)$C_6H_4$ | Ph | 87 | 1:2 |
| **f** | 4-$BrC_6H_4$ | Ph | 23 | 1:2 |
| **g** | Ph | Allyl | 53 | 1:3 |
| **h** | 4-$MeC_6H_4$ | Allyl | 56 | 1:3 |
| **i** | 4-(MeO)$C_6H_4$ | Allyl | 83 | 1:3 |
| **j** | 2-$MeC_6H_4$ | Allyl | 54 | 1:5 |
| **k** | 2-(MeO)$C_6H_4$ | Allyl | 52 | 1:3 |
| **l** | Ph | Me | 41 | 1:3 |
| **m** | Ph | Et | 75 | 1:3 |
| **n** | 4-$MeC_6H_4$ | Et | 90 | 1:2 |
| **o** | 4-(MeO)$C_6H_4$ | Et | 89 | 1:3 |
| **p** | 2-$MeC_6H_4$ | Et | 72 | 1:3 |
| **q** | 2-(MeO)$C_6H_4$ | Et | 72 | 1:2 |
| **r** | Ph | Pr | 67 | 1:3 |
| **s** | Ph | Bu | 70 | 1:3 |
| **t** | Ph | *i*-Bu | 67 | 1:5 |
| **u** | Thien-2-yl | Ph | 70 | 5:1 |
| **v** | Thien-2-yl | Allyl | 67 | 5:1 |
| **w** | Thien-2-yl | Et | 64 | 5:1 |

[a] Yields of isolated products.
[b] By $^1H$ NMR.

by the fact that the resonance of the $CH_3$ group (0.89 ppm) is significantly shifted upfield compared to the $CH_3$ group of the *E*-configured minor isomer (1.34 ppm) (Scheme 4). This can be explained by the fact that the $CH_3$ group of the *Z*-isomer is located within the anisotropic cone of the phenyl group. Similar effects are observed also for other derivatives. For example, the resonance of the $OCH_3$ group of *Z*-**5e** (3.52 ppm) is shifted upfield with respect to *E*-**5e** (3.69 ppm) (Scheme 5). The structure of *E*-**5v** (the minor isomer) was independently confirmed by crystal structure analysis (Fig. 1).[26]




**Scheme 4.** Structure of **5l**.




**Scheme 5.** Structure of **5e**.

In conclusion, we have reported the synthesis of 2-cyano-1-(hydroxymethyl)cyclopropanes by cyclization of dilithiated nitriles with epibromohydrin. 2-Cyanomethylidene-(4-hydroxymethyl)thiazolidines were prepared by one-pot cyclization of dilithiated nitriles with isothiocyanates and epibromohydrin.

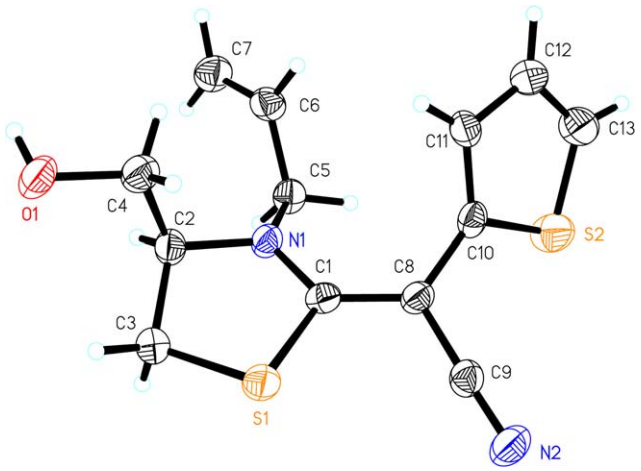



**Figure 1.** Crystal structure of *E*-**5v**.

## 3. Experimental

### 3.1. General comments

All solvents were dried by standard methods and all reactions were carried out under an inert atmosphere. For $^{1}H$ and $^{13}C$ NMR, the deuterated solvents indicated were used. Mass spectrometric data (MS) were obtained by electron ionization (70 eV), chemical ionization (CI, $H_2O$) or FT-ICR–MS. For preparative scale chromatography, silica gel (60–200 mesh) was used. Melting points are uncorrected.

### 3.2. Experimental procedures

**3.2.1. Experimental procedure for the synthesis of cyclopropanes (3a–j).** To a THF solution (20 mL) of phenylacetonitrile (0.58 g, 5.00 mmol) was added *n*-BuLi (10.48 mmol, 4.23 mL, solution in *n*-hexane) at 0 °C. The solution was stirred for 1 h and subsequently a THF solution (20 mL) of $LiClO_4$ (0.34 g) and epibromohydrin (0.33 g, 2.40 mmol) was added at −78 °C. The temperature was increased to −35 °C during 2 h and the solution was stirred at this temperature for 10 h. The solution was warmed to ambient during 1 h and stirred for 8 h. To the solution was added a saturated aqueous solution of $NH_4Cl$ (40 mL) and ether (50 mL). The organic layer was separated and the aqueous layer was extracted with ether (2×50 mL) and dichloromethane (2×50 mL). The combined organic layers were extracted with a saturated aqueous solution of NaCl, dried ($Na_2SO_4$), filtered and the solvent of the filtrate was removed in vacuo. The residue was purified by column chromatography (silica gel, petroleum ether/ether=4:1→1:1) to give **3a** as a colourless oil (330 mg, 79%, *Z*/*E*=8:1).

**3.2.2. 2-Cyano-1-(hydroxymethyl)-2-phenylcyclopropane (3a).** Starting with phenylacetonitrile (0.58 g, 5.00 mmol), **3a** was isolated as yellow oil (0.33 g, 79%, *E*/*Z*=1:8). $^{1}H$ NMR ($CDCl_3$, 250 MHz, major diastereomer): $\delta$=1.55 (m, 2H, CC$H_2$CH), 1.91 (m, 1H, CH), 3.34 (br, 1H, OH), 3.76 (dd, *J*=12 Hz, *J*=5 Hz, 1H, $CH_2$OH), 3.98 (dd, *J*=12 Hz, *J*=5 Hz, 1H, $CH_2$OH), 7.28 (m, 5H, Ph). $^{13}C$ NMR ($CDCl_3$, 75 MHz, major diastereomer): $\delta$=16.1 (CN), 21.2 ($CH_2$), 31.3 (CH), 62.6 ($CH_2$OH), 120.6 (C), 125.8, 127.6, 128.7 (CH–Ph), 135.5 (C). MS (EI, 70 eV): 173 ($M^+$, 18), 143 (24), 129 (100), 115 (26), 103 (34). HRMS (EI, 70 eV): calcd: *m*/*z*=173.0841 for $C_{11}H_{11}NO$ ($M^+$); found: *m*/*z*=173.0841±2 ppm. Anal. Calcd for $C_{11}H_{11}NO$: C, 76.28; H, 6.40. Found: C, 76.46; H, 6.28.

**3.2.3. 2-Cyano-1-(hydroxymethyl)-2-(*p*-tolyl)cyclopropane (3b).** Starting with *p*-tolylacetonitrile (0.65 g, 5.00 mmol), **3b** was isolated as a colourless oil (0.548 g, 56%, *E*/*Z*=1:7). IR (neat): $\tilde{\nu}$=3347 (br, m), 3088 (m), 3054 (m), 3035 (m), 3005 (m), 2948 (m), 2921 (m), 2873 (m), 2232 (w), 1764 (s), 1663 (s), 1592 (w), 1517 (s), 1448 (w), 1386 (m), 1367 (m), 1303 (w), 1248 (w), 1129 (w), 1111 (w), 1076 (m), 1039 (m), 1007 (m), 988 (w), 813 (w), 545 (w), 519 (w) $cm^{-1}$. $^{1}H$ NMR ($CDCl_3$, 250 MHz): $\delta$=1.55 (m, 2H, CC$H_2$CH), 1.92 (m, 1H, CH), 2.33 (s, 3H, $CH_3$), 3.14 (dd, $^{2}J$=12 Hz, $^{3}J$=9 Hz, A of AB, 1H, 0.5×C$H_2$OH, trans-diastereomer), 3.46 (dd, $^{2}J$=12 Hz, $^{3}J$=5 Hz, B of AB, 1H, 0.5×C$H_2$OH, trans-diastereomer), 3.78 (dd, $^{2}J$=12 Hz, $^{3}J$=8 Hz, A of AB, 1H, 0.5×C$H_2$OH, cis-diastereomer), 4.04 (dd, $^{2}J$=12 Hz, $^{3}J$=6 Hz, B of AB, 1H, 0.5×C$H_2$OH, cis-diastereomer), 7.19 (m, 4H, 4×CH, Ar). $^{13}C$ NMR ($CDCl_3$, 75 MHz, major diastereomer): $\delta_c$=16.0 (C), 20.9 ($CH_3$), 21.1 (C$CH_2$CH), 31.2 (CH), 63.0 ($CH_2$OH), 120.9 (CN), 126.0, 129.5 (CH, Ar), 132.6, 137.6 (C, Ar). MS (EI, 70 eV): 187 ($M^+$, 12), 157 (32), 143 (100), 115 (16). HRMS (EI, 70 eV): calcd: *m*/*z*=187.0997 for $C_{12}H_{13}NO$ ($M^+$); found: *m*/*z*=187.0997±2 ppm.

**3.2.4. 2-Cyano-1-(hydroxymethyl)-2-(*p*-methoxyphenyl)-cyclopropane (3c).** Starting with *p*-methoxyphenylacetonitrile (0.73 g, 5.00 mmol), **3c** was isolated as a colourless oil (0.48 g, 52%, *E*/*Z*=1:7). IR (neat): $\tilde{\nu}$=3324 (br, m), 3079 (m), 3039 (m), 3004 (w), 2960 (m), 2907 (m), 2839 (m), 2231 (m), 1763 (m), 1667 (s), 1611 (s), 1581 (m), 1515 (s), 1462 (s), 1447 (s), 1397 (m), 1368 (m), 1298 (m), 1249 (s), 1181 (s), 1108 (m), 1072 (m), 1033 (s), 963 (m), 833 (s), 585 (w), 551 (w) $cm^{-1}$. $^{1}H$ NMR ($CDCl_3$, 250 MHz): $\delta$=1.52 (m, 2H, CC$H_2$CH), 1.86 (m, 1H, CH), 2.37 (br, 1H, OH), 3.14 (dd, $^{2}J$=12 Hz, $^{3}J$=9 Hz, A of AB, 1H, 0.5×C$H_2$OH, trans-diastereomer), 3.45 (dd, $^{2}J$=12 Hz, $^{3}J$=5 Hz, B of AB, 1H, 0.5×C$H_2$OH, trans-diastereomer), 3.77 (dd, $^{2}J$=12 Hz, $^{3}J$=8 Hz, A of AB, 1H, 0.5×C$H_2$OH, cis-diastereomer), 3.78 (s, 3H, $CH_3$), 4.05 (dd, $^{2}J$=12 Hz, $^{3}J$=5 Hz, B of AB, 1H, 0.5×C$H_2$OH, cis-diastereomer), 6.84 (m, 2H, 2×CH, Ar), 7.23 (m, 2H, 2×CH, Ar). $^{13}C$ NMR ($CDCl_3$, 75 MHz, major diastereomer): $\delta_c$=16.2 (C), 20.7 (C$CH_2$CH), 30.8 (CH), 55.3 ($CH_3$), 63.0 ($CH_2$OH), 114.3 (CH, Ar), 121.1 (CN), 127.6 (C, Ar), 127.9 (CH, Ar), 159.2 (C, Ar). MS (EI, 70 eV): 203 ($M^+$, 32), 173 (57), 159 (100), 116 (11). HRMS (EI, 70 eV): calcd: *m*/*z*=203.0946 for $C_{12}H_{13}NO_2$ ($M^+$); found: *m*/*z*=203.0946±2 ppm.

**3.2.5. 2-Cyano-1-(hydroxymethyl)-2-(*m*-tolyl)cyclopropane (3d).** Starting with *m*-tolylacetonitrile (0.65 g, 5.00 mmol), **3d** was isolated as a yellow oil (0.32 g, 71%, *E*/*Z*=1:7). $^{1}H$ NMR ($CDCl_3$, 250 MHz, major diastereomer): $\delta$=1.59 (m, 2H, CC$H_2$CH), 1.95 (m, 1H, CH), 2.34 (s, 3H, $CH_3$), 3.79 (dd, $^{2}J$=12 Hz, $^{3}J$=8 Hz, A of AB, 1H, 0.5×C$H_2$OH), 4.06 (dd, $^{2}J$=12 Hz, $^{3}J$=5 Hz, A of AB, 1H, 0.5×C$H_2$OH), 7.18 (m, 4H, 4×CH, Ar). $^{13}C$ NMR ($CDCl_3$, 75 MHz, major diastereomer): $\delta_c$=16.1 (C), 21.2

(C*C*H$_2$CH), 21.3 (CH$_3$), 31.3 (CH), 63.1 (CH$_2$OH), 120.8 (CN), 122.9, 126.9, 128.5, 128.8 (CH, Ar), 135.5, 138.7 (C, Ar). MS (EI, 70 eV): 187 (M$^+$, 25), 143 (100), 142 (13), 115 (17). HRMS (EI, 70 eV): calcd: *m*/*z*=187.0997 for $C_{12}H_{13}NO$ (M$^+$); found: *m*/*z*=187.0997±2 ppm.

**3.2.6. 2-Cyano-1-(hydroxymethyl)-2-(*m*-methoxyphenyl)cyclopropane (3e).** Starting with *m*-methoxyphenylacetonitrile (0.73 g, 5.00 mmol), **3e** was isolated as a yellow oil (0.36 g, 75%, *E*/*Z*=1:6). $^1$H NMR (CDCl$_3$, 250 MHz, major diastereomer): $\delta$=1.59 (m, 2H, CC*H*$_2$CH), 1.91 (m, 1H, CH), 2.33 (br, 1H, OH), 3.80 (s, 3H, CH$_3$), 3.81 (dd, $^2J$=12 Hz, $^3J$=8 Hz, A of AB, 1H, 0.5×C*H*$_2$OH), 4.05 (dd, $^2J$=12 Hz, $^3J$=5 Hz, B of AB, 1H, 0.5×C*H*$_2$OH), 6.85 (m, 3H, 3×CH, Ar), 7.25 (m, 1H, CH, Ar). $^{13}$C NMR (CDCl$_3$, 75 MHz, major diastereomer): $\delta_c$=16.1 (C), 21.4 (C*C*H$_2$CH), 31.6 (CH), 55.3 (CH$_3$), 63.1 (CH$_2$OH), 112.1, 113.1, 118.1 (CH, Ar), 120.6 (CN), 130.0 (CH, Ar), 137.2, 160.0 (CH, Ar). MS (EI, 70 eV): 203 (M$^+$, 18), 173 (12), 159 (100). HRMS (EI, 70 eV): calcd: *m*/*z*=203.0946 for $C_{12}H_{13}NO_2$ (M$^+$); found: *m*/*z*=203.0946±2 ppm.

**3.2.7. 2-Cyano-1-(hydroxymethyl)-2-(*o*-tolyl)cyclopropane (3f).** Starting with *o*-tolylacetonitrile (0.65 g, 5.00 mmol), **3f** was isolated as a colourless oil (0.15 g, 34%, *E*/*Z*=1:5). IR (neat): $\tilde{\nu}$=3343 (br, m), 3126 (m), 3105 (m), 3003 (w), 2947 (m), 2907 (w), 2229 (w), 1765 (m), 1673 (w), 1587 (w), 1489 (m), 1452 (w), 1412 (w), 1387 (m), 1362 (m), 1309 (m), 1256 (w), 1105 (m), 1077 (m), 1044 (s), 999 (m), 977 (m), 960 (m), 722 (s) cm$^{-1}$. $^1$H NMR (CDCl$_3$, 250 MHz, major diastereomer): $\delta$=1.50 (m, 2H, CC*H*$_2$CH), 1.82 (m, 1H, CH), 2.54 (s, 3H, CH$_3$), 3.84 (dd, $^2J$=12 Hz, $^3J$=8 Hz, A of AB, 1H, 0.5×C*H*$_2$OH), 4.12 (dd, $^2J$=12 Hz, $^3J$=5 Hz, B of AB, 1H, 0.5×C*H*$_2$OH), 7.22 (m, 4H, 4×CH, Ar). $^{13}$C NMR (CDCl$_3$, 75 MHz, major diastereomer): $\delta_c$=17.0 (C), 19.3 (C*C*H$_2$CH), 19.4 (CH), 29.0 (CH$_3$), 63.0 (CH$_2$OH), 120.6 (CN), 126.3, 128.8, 129.5, 130.7 (CH, Ar), 133.5, 138.8 (C, Ar). MS (EI, 70 eV): 187 (M$^+$, 16), 157 (18), 143 (100), 115 (34). HRMS (EI, 70 eV): calcd: for *m*/*z*=187.0997 for $C_{12}H_{13}NO$ (M$^+$); found: *m*/*z*=187.0997±2 ppm.

**3.2.8. 2-Cyano-1-(hydroxymethyl)-2-(naphth-1-yl)cyclopropane (3g).** Starting with (naphth-1-yl)acetonitrile (0.83 g, 5.00 mmol), **3g** was isolated as a yellow oil (0.43 g, 81%, *E*/*Z*=1:5). IR (neat): $\tilde{\nu}$=3406 (br, m), 3056 (w), 2961 (w), 2932 (w), 2234 (m), 1261 (m), 1133 (w), 1100 (s), 1039 (s), 1023 (s), 860 (w), 817 (s), 748 (m), 478 (w) cm$^{-1}$. $^1$H NMR (CDCl$_3$, 250 MHz): $\delta$=1.69 (m, 2H, CC*H*$_2$CH, cis-diastereomer), 1.82 (m, 2H, CC*H*$_2$CH, trans-diastereomer), 2.06 (m, 1H, CH, cis-diastereomer), 2.22 (m, 1H, CH, trans-diastereomer), 2.47 (br, 1H, OH), 3.13 (dd, $^2J$=12 Hz, $^3J$=8 Hz, A of AB, 1H, 0.5×C*H*$_2$OH, trans-diastereomer), 3.49 (dd, $^2J$=12 Hz, $^3J$=6 Hz, B of AB, 1H, 0.5×C*H*$_2$OH, trans-diastereomer), 3.84 (dd, $^2J$=12 Hz, $^3J$=9 Hz, A of AB, 1H, 0.5×C*H*$_2$OH, cis-diastereomer), 4.12 (dd, $^2J$=12 Hz, $^3J$=5 Hz, B of AB, 1H, 0.5×C*H*$_2$OH, cis-diastereomer), 7.35 (m, 1H, CH, Ar), 7.51 (m, 2H, 2×CH, Ar), 7.82 (m, 4H, 4×CH, Ar). $^{13}$C NMR (CDCl$_3$, 75 MHz, major diastereomer): $\delta_c$=16.4 (C), 21.5 (C*C*H$_2$CH), 31.7 (CH), 63.3 (*C*H$_2$OH), 121.1 (CN), 123.7, 125.7, 126.7, 127.0, 127.9, 128.0, 129.2 (CH, Ar), 132.8, 133.1, 133.3 (C, Ar). MS (EI, 70 eV): 223 (M$^+$, 31), 193 (37), 179 (100), 165 (35). HRMS (EI, 70 eV): calcd: *m*/*z*=223.0997 for $C_{15}H_{13}NO$ (M$^+$); found: *m*/*z*=223.0997±2 ppm.

**3.2.9. 2-Cyano-1-(hydroxymethyl)-2-(*N*-methylpyrrolyl)cyclopropane (3h).** Starting with *N*-methylpyrrolylacetonitrile (0.60 g, 5.00 mmol), **3h** was isolated as a yellow oil (0.35 g, 83%, *E*/*Z*=1:3). LDA rather than *n*-BuLi was used. IR (neat): $\tilde{\nu}$=3343 (br, s), 3126 (m), 3105 (m), 3003 (w), 2947 (m), 2907 (m), 2229 (w), 1765 (m), 1673 (s), 1587 (w), 1489 (s), 1452 (m), 1412 (m), 1387 (m), 1362 (m), 1309 (s), 1256 (w), 1105 (m), 1077 (s), 1044 (s), 999 (w), 977 (w), 960 (w), 722 (s) cm$^{-1}$. $^1$H NMR (CDCl$_3$, 250 MHz, major diastereomer): $\delta$=1.48 (m, 1H, 0.5×CC*H*$_2$CH), 1.59 (m, 1H, 0.5×CC*H*$_2$CH), 1.84 (m, 1H, CH), 3.71 (m, A of AB, 1H, 0.5×C*H*$_2$OH), 3.78 (s, 3H, CH$_3$), 4.16 (dd, $^2J$=12 Hz, $^3J$=5 Hz, B of AB, 1H, 0.5×C*H*$_2$OH), 6.03 (m, 2H, 2×CH, Ar), 6.61 (m, 1H, CH, Ar). $^{13}$C NMR (CDCl$_3$, 75 MHz, major diastereomer): $\delta_c$=11.5 (C), 19.4 (C*C*H$_2$CH), 29.7 (CH), 34.0 (CH$_3$), 62.8 (CH$_2$OH), 107.0, 109.2 (CH, Ar), 120.0 (CN), 123.5 (CH, Ar), 126.3 (C, Ar). MS (EI, 70 eV): 176 (M$^+$, 44), 145 (100), 132 (54), 118 (15). HRMS (EI, 70 eV): calcd: *m*/*z*=176.0950 for $C_{10}H_{12}N_2O$ (M$^+$); found: *m*/*z*=176.0950±2 ppm.

**3.2.10. 2-Cyano-1-(hydroxymethyl)-2-(2-thienyl)cyclopropane (3i).** Starting with 2-thienylacetonitrile (0.61 g, 5.00 mmol), **3i** was isolated in two fractions as yellow oils (fraction A: *E*-**3i**: 168 mg, 39%, *E*/*Z*<2:98; fraction B: 182 mg, 43%, *E*/*Z*=4:1; combined yield of fractions A+B: 350 mg, 82%, *E*/*Z*=9:1). LDA rather than *n*-BuLi was used. IR (neat): $\tilde{\nu}$=3453 (s), 3376 (br, s), 3105 (m), 2972 (m), 2908 (m), 1765 (s), 1525 (s), 1470 (w), 1439 (m), 1384 (s), 1366 (s), 1346 (m), 1292 (m), 1251 (m), 1227 (m), 1111 (s), 1078 (s), 1037 (s), 994 (s), 850 (m), 702 (s) cm$^{-1}$. $^1$H NMR (CDCl$_3$, 250 MHz): cis-diastereomer: $\delta$=1.60 (d, $^3J$=7 Hz, 2H, CC*H*$_2$CH), 1.98 (m, 1H, CH), 3.02 (br, 1H, OH), 3.74 (dd, $^2J$=12 Hz, $^3J$=8 Hz, A of AB, 1H, 0.5×C*H*$_2$OH), 4.00 (dd, $^2J$=12 Hz, $^3J$=5 Hz, B of AB, 1H, 0.5×C*H*$_2$OH), 6.91 (dd, $^3J$=5 Hz, $^3J$=4 Hz, 1H, CH, Ar), 7.04 (dd, $^3J$=3 Hz, $^4J$=1 Hz, 1H, CH, Ar), 7.15 (dd, $^3J$=5 Hz, $^4J$=1 Hz, 1H, CH, Ar); trans-diastereomer: $\delta$=1.48 (m, 1H, A of AB, 0.5×CC*H*$_2$CH), 1.84 (m, 1H, B of AB, 0.5×CC*H*$_2$CH), 2.16 (m, 1H, CH), 2.74 (br, 1H, OH), 3.26 (dd, $^2J$=12 Hz, $^3J$=8 Hz, A of AB, 1H, 0.5×C*H*$_2$OH), 3.59 (dd, $^2J$=12 Hz, $^3J$=5 Hz, B of AB, 1H, 0.5×C*H*$_2$OH), 6.97 (dd, $^3J$=5 Hz, $^3J$=4 Hz, 1H, CH, Ar), 7.09 (dd, $^3J$=4 Hz, $^4J$=2 Hz, 1H, CH, Ar), 7.28 (dd, $^3J$=5 Hz, $^4J$=1 Hz, 1H, CH, Ar). $^{13}$C NMR (CDCl$_3$, 75 MHz, cis-diastereomer): $\delta_c$=15.0 (C), 22.7 (C*C*H$_2$CH), 32.5 (CH), 62.2 (*C*H$_2$OH), 119.9 (CN), 124.7, 125.9, 127.0 (CH, Ar), 139.6 (C, Ar). MS (EI, 70 eV): 179 (M$^+$, 18), 149 (27), 135 (100). HRMS (EI, 70 eV): calcd: *m*/*z*=179.0405 for $C_9H_9SNO$ (M$^+$); found: *m*/*z*=179.0405±2 ppm.

**3.2.11. 2-Cyano-1-(hydroxymethyl)-2-(trimethylsilyl)cyclopropane (3j).** Starting with trimethylsilylacetonitrile (0.56 g, 5.00 mmol), **3j** was isolated as a colourless oil (0.26 g, 65%, *E*/*Z*>98:2). LDA rather than *n*-BuLi was used. IR (neat): $\tilde{\nu}$=3408 (br, s), 3050 (w), 3017 (w), 2925 (m), 2883 (m), 2239 (m), 1765 (m), 1750 (m), 1661 (m), 1450 (m), 1412 (w), 1380 (m), 1056 (m), 1034 (s), 994 (m), 974 (m) cm$^{-1}$. $^1$H NMR (CDCl$_3$, 250 MHz): $\delta$=0.13

(s, 9H, $SiMe_3$), 1.06 (dd, $^2J$=8 Hz, $^3J$=5 Hz, A of AB, 1H, 0.5×CC$H_2$CH), 1.15 (dd, $^2J$=8 Hz, $^3J$=5 Hz, B of AB, 1H, 0.5×CC$H_2$CH), 1.46 (m, 1H, CH), 2.16 (br, 1H, OH), 3.68 (dd, $^2J$=12 Hz, $^3J$=7 Hz, A of AB, 1H, 0.5×C$H_2$OH), 3.93 (dd, $^2J$=12 Hz, $^3J$=6 Hz, B of AB, 1H, 0.5×C$H_2$OH). $^{13}$C NMR ($CDCl_3$, 75 MHz): $\delta_c$=−3.6 ($Si(CH_3)_3$), 1.0 (C), 15.6 (C$CH_2$CH), 24.4 (CH), 63.7 ($CH_2$OH), 122.4 (CN). MS (DCI, $NH_3$): 204 ((M+18+17)$^+$, 13), 187 ((M+18)$^+$, 100), 170 ((M+1)$^+$, 11). Anal. Calcd for $C_8H_{15}NOSi$: C, 56.75; H, 8.93. Found: C, 56.79; H, 8.98.

**3.2.12. 2-Cyano-1-(benzyloxymethyl)cyclopropane (3k).** To a THF suspension (15 mL) of NaH (99 mg, 4.2 mmol) was added **3j** (303 mg, 1.79 mmol) at 0 °C and the mixture was stirred for 30 min. Benzylic bromide (370 mg, 2.15 mmol) was added, the mixture was warmed to ambient and stirred for 2 d. An aqueous solution of $Na_2CO_3$ (50 mL, 10%) and ether was added; the organic and the aqueous layers were separated. The latter was extracted with ether (3×100 mL). The combined organic layers were washed with brine, dried ($Na_2SO_4$), filtered and the filtrate was concentrated in vacuo. The residue was purified by chromatography (silica gel, ether/petroleum ether=1:20→1:1) to give **3k** as a yellow oil (235 mg, 70%, *E*/*Z*=1:1). The diastereomers were separated by chromatography to give the pure trans-diastereomer *E*-**3k** (106 mg, 32%) and the cis-diastereomer *Z*-**3k** (97 mg, 29%). The isomers were assigned by NOESY experiments. IR (neat): $\tilde{\nu}$=3031 (w), 2863 (m), 2236 (w), 1452 (m), 1359 (m), 1093 (s), 1081 (s), 1029 (m), 741 (m), 700 (m) cm$^{-1}$. $^1$H NMR ($CDCl_3$, 250 MHz): trans-diastereomer: $\delta$=1.07 (m, 1H, NCCH), 1.23 (m, 1H, A of AB, 0.5×CHC$H_2$CH), 1.36 (m, 1H, B of AB, 0.5×CHC$H_2$CH), 1.79 (m, 1H, CH), 3.19 (dd, $^2J$=12 Hz, $^3J$=6 Hz, A of AB, 1H, 0.5×C$H_2$OBn), 3.52 (dd, $^2J$=12 Hz, $^3J$=5 Hz, B of AB, 1H, 0.5×C$H_2$OBn), 4.54 (s, 2H, C$H_2$Ph), 7.33 (m, 5H, 5×CH, Ar); cis-diastereomer: $\delta$=0.99 (m, 1H, A of AB, 0.5×CHC$H_2$CH), 1.27 (m, 1H, B of AB, 0.5×CHC$H_2$CH), 1.61 (m, 2×1H, 2×CH), 3.53 (dd, $^2J$=12 Hz, $^3J$=8 Hz, 1H, A of AB, 0.5×C$H_2$OBn), 3.75 (dd, $^2J$=12 Hz, $^3J$=5 Hz, 1H, B of AB, 0.5×C$H_2$OBz), 4.59 (s, 2H, C$H_2$Ph), 7.19 (m, 5H, 5×CH, Ar). $^{13}$C NMR ($CDCl_3$, 75 MHz, cis-diastereomer): $\delta_c$=1.0 (CH), 11.3 (C), 20.5 (CH), 69.4, 72.9 ($CH_2$), 121.4 (CN), 127.6, 127.8, 128.4 (CH, Ar), 137.6 (C, Ar). MS (EI, 70 eV): 187 (M$^+$, 10), 91 (100), 79.1 (8). HRMS (EI, 70 eV): calcd: *m*/*z*=187.0997 for $C_{12}H_{13}NO$ (M$^+$); found: *m*/*z*=187.0997±2 ppm.

**3.2.13. Typical procedure for the preparation of (4-hydroxymethyl)thiazolidines (5a–w).** To a THF solution (10 mL) of 4-tolylmethylnitrile (0.262 g, 2.0 mmol) was added *n*-butyllithium (4.4 mmol, 1.6 M) at 0 °C. After stirring for 1 h, ethylisothiocyanate (0.174 g, 2.0 mmol) was added and the solution was stirred for 1 h at 0 °C. Subsequently, epibromohydrin (0.274 g, 2.0 mmol) was added. After warming to 20 °C during 16 h, an aqueous solution of hydrochloric acid (20 mL, 1 M) was added. The organic and the aqueous layers were separated and the latter was extracted with ethyl acetate (3×30 mL). The combined organic layers were extracted with brine (30 mL), dried ($Na_2SO_4$), filtered and the solvent of the filtrate was removed in vacuo. The residue was purified by chromatography (silica gel, hexane/EtOAc=3:2) to give **5n** as colourless oil (0.491 g, 90%, *E*/*Z*=5:1).

**3.2.14. 2-(1-Cyano-1-phenyl)methylidene-4-hydroxymethyl-3-phenylthiazolidine (5a).** Starting with phenylacetonitrile (0.234 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), phenylisothiocyanate (0.270 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5a** was isolated as a colourless solid (0.507 g, 1.65 mmol, 82%, *E*/*Z*=2:1). Mp 143 °C. IR (KBr): $\tilde{\nu}$=3459 (s), 2184 (s), 1594 (w), 1544 (s), 1492 (m) cm$^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=239.85 (4.05), 254.93 (4.02), 276.16 (4.02), 331.10 (4.06) nm. $^1$H NMR ($CDCl_3$, 300 MHz): $\delta$=3.19 (dd, $^3J$=7 Hz, $^3J$=4 Hz, 1H, $CH_2$, *Z*), 3.22 (dd, $^3J$=7 Hz, $^3J$=4 Hz, 1H, $CH_2$, *E*), 3.32 (dd, $^3J$=7 Hz, $^3J$=4 Hz, 1H, $CH_2$, *E*), 3.33 (dd, $^3J$=7 Hz, $^3J$=4 Hz, 1H, $CH_2$, *Z*), 3.67 (dd, $^3J$=11 Hz, $^3J$=7 Hz, 1H, CH, *Z*), 3.74 (dd, $^3J$=11 Hz, $^3J$=7 Hz, 1H, CH, *E*), 3.85 (dd, $^3J$=11 Hz, $^3J$=7 Hz, 1H, CH, *Z*), 3.89 (dd, $^3J$=11 Hz, $^3J$=7 Hz, 1H, CH, *E*), 3.95 (dd, $^3J$=11 Hz, $^3J$=7 Hz, 1H, CH, *E*), 3.98 (dd, $^3J$=11 Hz, $^3J$=7 Hz, 1H, CH, *Z*), 4.25 (dddd, $^3J$=11 Hz, $^3J$=7 Hz, $^3J$=7 Hz, $^3J$=4 Hz, 1H, CH, *E*), 4.36 (dddd, $^3J$=11 Hz, $^3J$=7 Hz, $^3J$=7 Hz, $^3J$=4 Hz, 1H, CH, *Z*), 6.77–6.98 (m, 6H, CH, *E*, *Z*), 7.19–7.47 (m, 4H, CH, *E*, *Z*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=30.02 (*Z*), 30.75 (*E*), 61.11 (*E*), 61.55 (*Z*) ($CH_2$), 70.72 (*E*), 72.70 (*Z*) (CH), 80.20 (*E*), 81.82 (*Z*), 118.60 (*E*), 122.13 (*Z*) (C), 122.57 (*E*), 124.67 (*Z*), 125.87 (*E*), 127.08 (*Z*), 127.24 (*E*), 127.50 (*Z*), 128.36 (*Z*), 128.47 (*E*), 128.49 (*E*), 128.57 (*Z*), 128.58 (*Z*), 129.51 (*E*) (CH), 132.59 (*Z*), 135.79 (*E*), 141.60 (*Z*), 142.42 (*E*), 158.32 (*Z*), 162.36 (*E*) (C). MS (EI, 70 eV): *m*/*z*=308 (M$^+$, 7), 277 (10), 250 (1), 77 (8), 28 (100). Anal. Calcd for $C_{18}H_{16}N_2OS$: C, 70.10; H, 5.23; N, 9.08. Found: C, 69.86; H, 5.26; N, 8.86.

**3.2.15. 2-(1-Cyano-1-(4-tolyl))methylidene-4-hydroxymethyl-3-phenylthiazolidine (5b).** Starting with 4-tolylacetonitrile (0.262 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), phenylisothiocyanate (0.270 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5b** was isolated as a colourless solid (0.553 g, 1.72 mmol, 86%, *E*/*Z*=3:1). Mp 85 °C. IR (KBr): $\tilde{\nu}$=3477 (s), 2188 (s), 1592 (w), 1570 (w), 1544 (s), 1510 (w), 1492 (m) cm$^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=240.34 (4.08), 256.84 (4.02), 276.90 (4.02), 332.23 (4.07) nm. $^1$H NMR (acetone-$d_6$, 300 MHz): $\delta$=2.32 (s, 3H, $CH_3$, *E*), 2.87 (s, 3H, $CH_3$, *Z*), 3.31 (dd, $^3J$=7 Hz, $^2J$=11 Hz, 1H, $CH_2$, *Z*), 3.34 (dd, $^3J$=6 Hz, $^2J$=11 Hz, 1H, $CH_2$, *E*), 3.48 (dd, $^3J$=7 Hz, $^2J$=11 Hz, 1H, $CH_2$, *Z*), 3.53 (dd, $^3J$=7 Hz, $^2J$=11 Hz, 1H, $CH_2$, *E*), 3.74 (dd, $^3J$=7 Hz, $^2J$=11 Hz, 1H, $CH_2$, *Z*), 3.83 (dd, $^3J$=7 Hz, $^2J$=11 Hz, 1H, $CH_2$, *E*), 4.08 (dd, $^3J$=7 Hz, $^2J$=11 Hz, 1H, $CH_2$, *E*), 4.31–4.37 (m, 1H, CH, *E*, *Z*), 6.77 (d, $^3J$=8 Hz, 2H, CH, *E*), 6.83 (d, $^3J$=8 Hz, 2H, CH, *Z*), 6.96 (d, $^3J$=8 Hz, 2H, CH, E), 7.02 (d, $^3J$=8 Hz, 2H, CH, *Z*), 7.08 (dd, $^3J$=8 Hz, $^2J$=2 Hz, 1H, CH, *E*), 7.09 (dd, $^3J$=8 Hz, $^2J$=2 Hz, 1H, CH, *Z*), 7.18 (dd, $^3J$=8 Hz, $^2J$=2 Hz, 2H, CH, *E*), 7.24 (dd, $^3J$=8 Hz, $^2J$=2 Hz, 2H, CH, *Z*), 7.35 (dd, $^3J$=8 Hz, $^4J$=2 Hz, 2H, CH, *E*), 7.42 (dd, $^3J$=8 Hz, $^4J$=2 Hz, 2H, CH, *Z*). $^{13}$C NMR (acetone-$d_6$, 75 MHz): $\delta$=21.35 (*E*), 21.49 (*Z*) ($CH_3$), 30.99 (*E*), 31.81 (*Z*), 62.13 (*Z*), 62.86 (*E*) ($CH_2$), 72.81 (*Z*), 74.70 (*E*) (CH), 81.98 (*Z*), 84.00 (*E*), 119.14 (*Z*), 122.48 (*E*) (C), 123.90 (*E*), 125.44 (*Z*), 126.97 (*E*), 128.35 (*Z*), 129.45 (*E*), 129.60 (*Z*), 129.79 (*E*), 129.81 (*Z*), 130.37 (*Z*), 130.49 (*E*) (CH), 131.93 (*E*), 135.21 (*Z*), 136.58 (*E*), 137.93 (*Z*), 144.04 (*E*), 144.97 (*Z*), 158.75 (*E*), 162.71 (*Z*). MS (EI, 70 eV)

*m*/*z*=322 ($M^+$, 100), 291 (99), 264 (10), 232 (5), 188 (7). HRMS (EI, 70 eV): calcd: *m*/*z* (%)=322.1140 for $C_{19}H_{18}N_2OS$ ($M^+$); found: *m*/*z* (%)=322.1140±2 ppm.

**3.2.16. 2-(1-Cyano-1-(4-methoxyphenyl))methylidene-4-hydroxymethyl-3-phenylthiazolidine (5c).** Starting with 4-(methoxyphenyl)acetonitrile (0.294 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), phenylisothiocyanate (0.270 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5c** was isolated as a colourless solid (0.638 g, 1.89 mmol, 94%, *E*/*Z*=2:1). Mp 123 °C. IR (KBr): $\tilde{\nu}$=3420 (s), 2938 (w), 2910 (w), 2879 (w), 2836 (w), 2184 (s), 1601 (w), 1544 (s), 1510 (s), 1492 (m), 1461 (w), 1415 (w) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=214.46 (4.25), 239.89 (4.13), 280.10 (4.06), 332.13 (4.04) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=2.99–3.29 (m, 2H, $CH_2$, *E*, *Z*), 3.52 (s, 3H, $CH_3$, *Z*), 3.69 (s, 3H, $CH_3$, *E*), 3.57–3.85 (m, 2H, $CH_2$, *E*, *Z*), 4.12–4.27 (m, 1H, CH, *E*, *Z*), 6.37 (dd, $^3J$=7 Hz, $^4J$=2 Hz, 1H, CH, *E*, *Z*), 6.71–6.89 (m, 4H, CH, *E*, *Z*), 7.15–7.33 (m, 4H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=29.95 (*Z*), 30.68 (*E*) ($CH_2$), 54.99 (*Z*), 55.14 (*E*) ($CH_3$), 60.97 (*E*), 61.42 (*Z*) ($CH_2$), 70.75 (*E*), 72.57 (*Z*) (CH), 79.06 (*E*), 81.40 (*Z*) (C), 112.96 (*Z*), 113.83 (*E*) (CH), 118.72 (*E*), 122.26 (*Z*) (C), 122.47 (*E*), 124.53 (*Z*) (CH), 125.02 (*Z*) (C), 125.81 (*E*), 126.89 (*Z*) (CH), 128.04 (*E*) (C), 128.24 (*Z*), 128.38 (*E*), 129.38 (*Z*), 130.01 (*E*) (CH), 141.44 (*Z*), 142.33 (*E*), 157.07 (*Z*), 157.51 (*E*), 158.58 (*E*), 161.95 (*Z*) (C). MS (EI, 70 eV) *m*/*z*=338 ($M^+$, 100), 307 (51), 280 (12), 248 (3), 233 (7). HRMS (EI, 70 eV): calcd: *m*/*z* (%)=338.1089 for $C_{19}H_{18}N_2O_2S$ ($M^+$); found: *m*/*z* (%)=338.1089±2 ppm. Anal. Calcd for $C_{19}H_{18}N_2O_2S$: C, 67.43; H, 5.36; N, 8.28. Found: C, 67.63; H, 5.74; N, 8.19.

**3.2.17. 2-(1-Cyano-1-(2-tolyl))methylidene-4-hydroxymethyl-3-phenylthiazolidine (5d).** Starting with 2-tolylacetonitrile (0.262 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), phenylisothiocyanate (0.270 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5d** was isolated as a colourless solid (0.438 g, 1.50 mmol, 75%, *E*/*Z*=2:1). Mp 146 °C. IR (KBr): $\tilde{\nu}$=3411 (s), 2181 (s), 1593 (w), 1547 (s), 1491 (s), 1454 (w) $cm^{-1}$. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=2.13 (s, 3H, $CH_3$, *Z*), 2.33 (s, 3H, $CH_3$, *E*), 3.13–3.35 (m, 2H, $CH_2$, *E*, *Z*), 3.63–3.66 (m, 2H, $CH_2$, *E*, *Z*), 4.12–4.20 (m, 1H, CH, *E*, *Z*), 6.73–6.89 (m, 4H, CH, *E*, *Z*), 7.14–7.44 (m, 5H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=19.59 (*E*), 19.73 (*Z*) ($CH_3$), 30.23 (*E*), 30.35 (*Z*), 60.80 (*E*), 60.93 (*Z*) ($CH_2$), 71.49 (*E*), 72.59 (*Z*) (CH), 74.91 (*E*), 78.14 (*Z*), 117.74 (*E*), 121.98 (*Z*) (C), 124.27 (*E*), 125.21 (*Z*), 125.52 (*Z*), 126.07 (*E*), 126.93 (*E*), 127.12 (*Z*), 127.64 (*Z*), 128.10 (*E*), 128.52 (*Z*), 129.43 (*E*), 129.59 (*Z*), 130.29 (*E*), 130.41 (*Z*), 131.33 (*E*) (CH), 131.82 (*Z*), 134.86 (*E*), 136.13 (*Z*), 138.01 (*E*), 141.03 (*Z*), 141.37 (*E*), 160.34 (*Z*), 163.73 (*E*) (C). MS (EI, 70 eV) *m*/*z*=322 ($M^+$, 84), 291 (100), 264 (9), 231 (6), 188 (4). HRMS (EI, 70 eV): calcd: *m*/*z* (%)=322.1140 for $C_{19}H_{18}N_2OS$ ($M^+$); found: *m*/*z* (%)=322.1140±2 ppm.

**3.2.18. 2-(1-Cyano-1-(2-methoxyphenyl))methylidene-4-hydroxymethyl-3-phenylthiazolidine (5e).** Starting with 2-(methoxyphenyl)acetonitrile (0.294 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), phenylisothiocyanate (0.270 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5e** was isolated as a colourless solid (0.590 g, 1.74 mmol, 87%, *E*/*Z*=2:1). Mp 145 °C. IR (KBr): $\tilde{\nu}$=3446 (s), 2950 (m), 2178 (s), 1594 (m), 1543 (s), 1491 (s), 1454 (m), 1433 (w) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=296.72 (4.03), 323.21 (4.04) nm. $^1H$ NMR (acetone-$d_6$, 300 MHz): $\delta$=3.25 (dd, $^3J$=11 Hz, $^3J$=7 Hz, 2H, $CH_2$, *Z*), 3.44 (dd, $^3J$=11 Hz, $^3J$=7 Hz, 2H, $CH_2$, *E*), 3.68 (s, 3H, $CH_3$, *Z*), 3.73 (s, 3H, $CH_3$, *E*), 3.90–4.17 (m, 2H, $CH_2$, *E*, *Z*), 4.33–4.42 (m, 1H, CH, *E*, *Z*), 6.44–6.52 (m, 1H, CH, *Z*), 6.56–6.64 (m, 1H, CH, *E*), 6.67–6.81 (m, 1H, CH, *E*, *Z*), 6.86–7.07 (m, 5H, CH, *E*, *Z*), 7.18–7.52 (m, 2H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, acetone-$d_6$): $\delta$=31.04 (*E*), 31.54 (*Z*) ($CH_2$), 56.01 (*E*), 56.70 (*Z*) ($CH_3$), 59.06 (*Z*), 62.36 (*E*) ($CH_2$), 73.91 (*Z*), 74.23 (*E*) (CH), 77.54 (*Z*), 77.66 (*E*) (C), 111.71 (*E*), 113.03 (*Z*), 121.29 (*E*), 121.93 (*Z*) (CH), 123.05 (*E*), 124.07 (*Z*), 124.54 (*E*) (C), 124.67 (*E*) (CH), 124.93 (*Z*) (C), 125.79 (*Z*), 127.13 (*E*), 127.49 (*Z*), 129.13 (*E*), 129.81 (*Z*), 130.58 (*Z*), 131.31 (*E*), 131.53 (*E*), 131.91 (*Z*) (CH), 142.71 (*E*), 144.99 (*Z*), 157.05 (*E*), 159.25 (*Z*), 160.87 (*Z*), 164.19 (*E*) (C). MS (EI, 70 eV): *m*/*z*=338 ($M^+$, 100), 307 (39), 274 (3), 243 (3), 207 (5). Anal. Calcd for $C_{19}H_{18}N_2O_2S$: C, 67.43; H, 5.36; N, 8.28. Found: C, 67.13; H, 5.77; N, 8.29.

**3.2.19. 2-(1-Cyano-1-(4-bromophenyl))methylidene-4-hydroxymethyl-3-phenylthiazolidine (5f).** Starting with 4-(bromophenyl)acetonitrile (0.390 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), phenylisothiocyanate (0.270 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5f** was isolated as a colourless solid (0.182 g, 0.47 mmol, 23%, *E*/*Z*=2:1). Mp 140–143 °C. IR (KBr): $\tilde{\nu}$=3453 (s), 2186 (s), 1594 (w), 1537 (s), 1490 (s), 1443 (w) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=240.09 (4.10), 277.52 (4.06), 336.59 (4.08) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=3.18–3.47 (m, 2H, $CH_2$, *E*, *Z*), 3.79–4.04 (m, 2H, $CH_2$, *E*, *Z*), 4.27–4.42 (m, 1H, CH, *Z*), 4.44–4.56 (m, 1H, CH, *E*), 6.83–7.05 (m, 4H, CH, *E*, *Z*), 7.24–7.43 (m, 5H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=30.27 (*Z*), 30.83 (*E*), 61.56 (*Z*), 62.07 (*E*) ($CH_2$), 70.84 (*E*), 72.86 (*Z*) (CH), 79.48 (*E*), 79.49 (*Z*), 119.61 (*E*), 120.98 (*Z*) (C), 122.72 (*Z*), 122.91 (*E*) (CH), 126.04 (*Z*), 126.31 (*E*) (C), 127.37 (*Z*), 127.67 (*E*), 128.70 (*Z*), 128.82 (*E*), 129.78 (*E*), 130.34 (*Z*), 130.67 (*Z*), 131.67 (*E*) (CH), 135.01 (*E*), 135.70 (*Z*), 141.76 (*E*), 142.17 (*Z*), 162.33 (*E*), 162.34 (*Z*) (C). MS (EI, 70 eV): *m*/*z*=388 ($M^+$, 16), 357 (12), 308 (47), 277 (65), 218 (4), 77 (100). HRMS (EI, 70 eV): calcd: *m*/*z*=386.0089 for $C_{18}H_{15}BrN_2OS$ [$M^+$]; found: *m*/*z*=386.0089±2 ppm.

**3.2.20. 2-(1-Cyano-1-phenyl)methylidene-4-hydroxymethyl-3-allylthiazolidine (5g).** Starting with phenylacetonitrile (0.234 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), allylisothiocyanate (0.198 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5g** was isolated as a colourless oil (0.286 g, 1.05 mmol, 53%, *E*/*Z*=3:1). IR (KBr): $\tilde{\nu}$=3412 (s), 2927 (w), 2178 (s), 1535 (s), 1492 (w), 1442 (s) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=310.07 (4.12) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=3.00–3.23 (m, 2H, $CH_2$, *E*, *Z*), 3.44–3.54 (m, 2H, $CH_2$, *E*, *Z*), 3.57–3.69 (m, 2H, $CH_2$, *E*, *Z*), 3.99–4.06 (m, 1H, CH, *E*, *Z*), 4.16 (m, 1H, $CH_2$, *Z*), 4.63 (m, 1H, $CH_2$. *E*), 5.00 (dd, $^2J$=1 Hz, $^3J_{trans}$=17 Hz, 1H, $CH_2$, *Z*), 5.28 (dd, $^2J$=1 Hz, $^3J_{trans}$=17 Hz, 1H, $CH_2$, *E*), 5.46 (m, 1H, CH,

*Z*), 5.94 (m, 1H, CH, *E*), 7.12–7.32 (m, 4H, CH, *E*, *Z*), 7.38–7.43 (m, 1H, CH, *E*, *Z*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=29.50 (*Z*), 29.61 (*E*), 52.18 (*E*), 53.64 (*Z*), 60.56 (*E*), 61.16 (*Z*) ($CH_2$), 68.11 (*Z*), 68.33 (*E*) (CH), 72.99 (*E*), 75.17 (*Z*) (C), 118.24 (*E*), 119.10 (*Z*) ($CH_2$), 121.11 (*E*), 123.24 (*Z*) (C), 126.37 (*Z*), 126.84 (*E*), 128.17 (*Z*), 128.32 (*E*), 128.40 (*Z*), 129.16 (*E*), 131.69 (*Z*), 132.33 (*E*) (CH), 133.75 (*Z*), 136.43 (*E*), 162.27 (*E*), 163.35 (*Z*) (C). MS (EI, 70 eV) *m*/*z*=272 ($M^+$, 32), 241 (40), 232 (100), 200 (30), 173 (10). HRMS (EI, 70 eV): calcd: *m*/*z*=272.0983 for $C_{15}H_{16}N_2OS$ ($M^+$); found: *m*/*z*=272.0983±2 ppm. Anal. Calcd for $C_{15}H_{16}N_2OS$: C, 66.15; H, 5.92; N, 10.29. Found: C, 65.92; H, 5.89; N, 10.27.

**3.2.21. 2-(1-Cyano-1-(4-tolyl))methylidene-4-hydroxymethyl-3-allylthiazolidine (5h).** Starting with 4-tolylacetonitrile (0.262 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), allylisothiocyanate (0.198 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5h** was isolated as a colourless oil (0.32 g, 1.11 mmol, 56%, *E*/*Z*=3:1). IR (KBr): $\tilde{\nu}$=3426 (s), 3083 (w), 3024 (m), 2975 (m), 2942 (s), 2872 (m), 2178 (s), 1687 (w), 1643 (m), 1612 (w), 1548 (s), 1443 (s), 1411 (m) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=306.97 (4.11) nm. $^1$H NMR ($CDCl_3$, 300 MHz): $\delta$=2.27 (s, 3H, $CH_3$, *Z*), 2.31 (s, 3H, $CH_3$, *E*), 3.00–3.23 (m, 2H, $CH_2$, *E*, *Z*), 3.43–3.67 (m, 4H, $CH_2$, *E*, *Z*), 3.97–4.06 (m, 1H, CH, *E*, *Z*), 4.14 (dd, $^2J$=1 Hz, $^3J_{cis}$=10 Hz, 1H, CH, *Z*), 4.62 (dd, $^2J$=1 Hz, $^3J_{cis}$=10 Hz, 1H, CH, *E*), 5.03 (dd, $^2J$=1 Hz, $^3J_{trans}$=17 Hz, 1H, CH, *Z*), 5.29 (dd, $^2J$=1 Hz, $^3J_{trans}$=17 Hz, 1H, CH, *E*), 5.43–5.54 (m, 1H, CH, *Z*), 5.87–6.00 (m, 1H, CH, *E*), 7.06–7.16 (m, 2H, CH, *E*, *Z*), 7.27–7.30 (m, 2H, CH, *E*, *Z*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=20.97 (*E*), 25.38 (*Z*) ($CH_3$), 29.54 (*Z*), 29.62 (*E*), 52.14 (*E*), 53.41 (*Z*), 60.59 (*E*), 61.14 (*Z*) ($CH_2$), 68.09 (*Z*), 68.36 (*E*) (CH), 72.87 (*E*), 75.28 (*Z*) (C), 118.14 (*E*), 118.94 (*Z*) ($CH_2$), 121.15 (*E*), 123.29 (*Z*) (C), 128.11 (*Z*), 129.03 (*E*), 129.08 (*E*), 129.09 (*Z*) (CH), 130.70 (*Z*) (C), 131.82 (*Z*), 132.42 (*E*) (CH), 133.47 (*E*), 136.18 (*Z*), 136.69 (*E*), 161.73 (*Z*), 163.06 (*E*) (C). MS (EI, 70 eV) *m*/*z*=286 ($M^+$, 42), 255 (33), 246 (100), 214 (28), 187 (17). HRMS (EI, 70 eV): calcd: *m*/*z*=286.1140 for $C_{16}H_{18}N_2OS$ ($M^+$); found: *m*/*z*=286.1140±2 ppm.

**3.2.22. 2-(1-Cyano-1-(4-methoxyphenyl))methylidene-4-hydroxymethyl-3-allylthiazolidine (5i).** Starting with 4-(methoxyphenyl)acetonitrile (0.294 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), allylisothiocyanate (0.198 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5i** was isolated as a colourless oil (0.499 g, 1.65 mmol, 83%, *E*/*Z*=3:1). IR (KBr): $\tilde{\nu}$=3422 (s), 3076 (w), 3033 (w), 2939 (s), 2877 (m), 2836 (m), 2176 (s), 1692 (w), 1642 (m), 1605 (s), 1550 (s), 1510 (s), 1445 (s), 1415 (s) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=232.44 (4.01), 301.58 (4.12) nm. $^1$H NMR ($CDCl_3$, 300 MHz): $\delta$=2.91–3.24 (m, 2H, $CH_2$, *E*, *Z*), 3.43–3.67 (m, 4H, $CH_2$, *E*, *Z*), 3.76 (s, 3H, $CH_3$, *Z*), 3.77 (s, 3H, $CH_3$, *E*), 3.98–4.04 (m, 1H, CH, *E*, *Z*), 4.16 (dd, $^2J$=1 Hz, $^3J_{cis}$=10 Hz, 1H, CH, *Z*), 4.62 (dd, $^2J$=1 Hz, $^3J_{cis}$=10 Hz, 1H, CH, *E*), 5.03 (dd, $^2J$=1 Hz, $^3J_{trans}$=17 Hz, 1H, CH, *Z*), 5.29 (dd, $^2J$=1 Hz, $^3J_{trans}$=17 Hz, 1H, CH, *E*), 5.42–5.53 (m, 1H, CH, *Z*), 5.89–5.98 (m, 1H, CH, *E*), 6.82–6.87 (m, 2H, CH, *E*, *Z*), 7.18 (d, $^3J$=7 Hz, 2H, CH, *Z*), 7.19 (d, $^3J$=7 Hz, 2H, CH, *E*), 7.30 (d, $^3J$=7 Hz, 2H, CH, *Z*), 7.31 (d, $^3J$=7 Hz, 2H, CH, *E*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=29.30 (*Z*), 29.51 (*E*), 51.84 (*E*), 52.99 (*Z*) ($CH_2$), 55.05 (*E*), 55.06 (*Z*) ($CH_3$), 60.62 (*E*), 61.03 (*Z*) ($CH_2$), 68.15 (*Z*), 68.43 (*E*) (CH), 71.92 (*E*), 74.67 (*Z*) (C), 113.67 (*E*), 113.79 (*Z*) (CH), 118.00 (*E*), 118.69 (*Z*) ($CH_2$), 121.18 (*E*), 123.31 (*Z*), 128.25 (*Z*), 128.71 (*E*) (C), 129.59 (*Z*), 130.63 (*E*), 131.76 (*Z*), 132.34 (*E*) (CH), 157.98 (*Z*), 158.40 (*E*), 161.21 (*Z*), 162.99 (*E*) (C). MS (EI, 70 eV) *m*/*z*=302 ($M^+$, 80), 271 (35), 262 (100), 230 (40), 203 (36). Anal. Calcd for $C_{19}H_{18}N_2O_2S$: C, 67.43; H, 5.36; N, 8.28. Found: C, 67.72; H, 5.78; N, 8.46.

**3.2.23. 2-(1-Cyano-1-(2-tolyl))methylidene-4-hydroxymethyl-3-allylthiazolidine (5j).** Starting with 2-tolylacetonitrile (0.262 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), allylisothiocyanate (0.198 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5j** was isolated as a colourless oil (0.31 g, 1.08 mmol, 54%, *E*/*Z*=5:1). IR (KBr): $\tilde{\nu}$=3412 (s), 3075 (w), 3002 (w), 2938 (s), 2877 (m), 2837 (m), 2174 (s), 1675 (m), 1643 (m), 1593 (m), 1552 (s), 1536 (s), 1489 (s), 1455 (s), 1438 (s) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=305.12 (4.00) nm. $^1$H NMR ($CDCl_3$, 300 MHz): $\delta$=2.26 (s, 3H, $CH_3$, *Z*), 2.32 (s, 3H, $CH_3$, *E*), 2.93 (dd, $^2J$=11 Hz, $^3J$=3 Hz, 1H, $CH_2$, *Z*), 2.97 (dd, $^2J$=11 Hz, $^3J$=3 Hz, 1H, $CH_2$, *E*), 3.08 (ddd, $^2J$=11 Hz, $^3J$=7 Hz, $^3J$=4 Hz, 1H, $CH_2$, *E*), 3.12 (ddd, $^2J$=11 Hz, $^3J$=7 Hz, $^3J$=4 Hz, 1H, $CH_2$, *Z*), 3.21–3.39 (m, 2H, $CH_2$, *E*, *Z*), 3.61–3.72 (m, 2H, $CH_2$, *E*, *Z*), 3.91–4.04 (m, 1H, CH, *E*, *Z*), 4.15 (dd, $^2J$=1 Hz, $^3J_{cis}$=10 Hz, 1H, CH, *Z*), 4.73 (dd, $^2J$=1 Hz, $^3J_{cis}$=10 Hz, 1H, CH, *E*), 4.82–5.04 (m, 1H, CH, *Z*), 5.27–5.33 (m, 1H, CH, *E*), 5.31–5.42 (m, 1H, CH, *Z*), 5.88–6.01 (m, 1H, CH, *E*), 7.12–7.24 (m, 4H, CH, *E*, *Z*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=19.56 (*Z*), 19.74 (*E*) ($CH_3$), 29.31 (*E*), 29.56 (*Z*), 50.93 (*E*), 50.94 (*Z*), 60.70 (*E*), 60.82 (*Z*) ($CH_2$), 68.87 (*Z*), 69.17 (*E*) (CH), 69.87 (*E*), 69.88 (*Z*) (C), 117.72 (*E*), 117.96 (*Z*) ($CH_2$), 120.38 (*E*), 120.39 (*Z*) (C), 125.99 (*Z*), 126.03 (*E*), 127.94 (*Z*), 128.43 (*E*), 130.23 (*E*), 130.73 (*Z*), 131.53 (*Z*), 131.73 (*E*), 132.19 (*E*), 132.42 (*Z*) (CH), 135.37 (*E*), 135.38 (*Z*), 137.69 (*Z*), 138.24 (*E*), 163.30 (*Z*), 163.31 (*E*). MS (EI, 70 eV) *m*/*z*=286 ($M^+$, 93), 255 (100), 246 (93), 214 (32), 128 (13). Anal. Calcd for $C_{19}H_{18}N_2OS$: C, 70.78; H, 5.63; N, 8.69. Found: C, 70.89; H, 5.82; N, 8.49.

**3.2.24. 2-(1-Cyano-1-(2-methoxyphenyl))-methylidene-4-hydroxymethyl-3-allylthiazolidine (5k).** Starting with (2-methoxyphenyl)acetonitrile (0.294 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), allylisothiocyanate (0.198 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5k** was isolated as a colourless solid (0.590 g, 1.74 mmol, 87%). IR (KBr): $\tilde{\nu}$=3415 (s), 2975 (w), 2936 (m), 2843 (w), 2177 (s), 1549 (s), 1490 (m), 1457 (m), 1441 (s) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=309.61 (4.06) nm. $^1$H NMR (acetone-$d_6$, 300 MHz): $\delta$=2.62 (dd, $^2J$=14 Hz, $^3J$=5 Hz, 1H, CH, *Z*), 2.77 (dd, $^2J$=14 Hz, $^3J$=5 Hz, 1H, CH, *E*), 3.04 (dd, $^2J$=11 Hz, $^3J$=4 Hz, 1H, $CH_2$, *Z*), 3.17 (dd, $^2J$=11 Hz, $^3J$=4 Hz, 1H, $CH_2$, *E*), 3.18–3.38 (m, 2H, $CH_2$, *E*), 3.39–3.59 (m, 2H, $CH_2$, *Z*), 3.67–3.76 (m, 2H, *E*, *Z*), 3.81 (s, 3H, $CH_3$, *Z*), 3.82 (s, 3H, $CH_3$, *E*), 4.05–4.35 (m, 1H, CH, *E*, *Z*), 4.40–4.57 (m, 1H, $CH_2$, *E*), 4.73–4.83 (m, 1H, $CH_2$, *Z*), 4.98 (dd, $^2J$=2 Hz, $^3J_{trans}$=16 Hz, $^3J_{cis}$=10 Hz, 1H, $CH_2$, *E*), 5.33 (dd, $^2J$=2 Hz, $^3J_{trans}$=16 Hz, $^3J_{cis}$=10 Hz,

1H, $CH_2$, *Z*), 5.51 (ddt, $^3J_{trans}$=16 Hz, $^3J_{cis}$=10 Hz, $^3J$=6 Hz, 1H, *E*), 6.03 (ddt, $^3J_{trans}$=16 Hz, $^3J_{cis}$=10 Hz, $^3J$=6 Hz, 1H, *Z*), 6.88–7.01 (m, 2H, CH, *E*, *Z*), 7.19–7.33 (m, 2H, CH, *E*, *Z*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=36.30 (*Z*), 36.72 (*E*), 52.31 (*Z*), 52.71 (*E*) ($CH_2$), 56.16 (*Z*), 56.41 (*E*) ($CH_3$), 61.66 (*E*), 61.85 (*Z*) ($CH_2$), 68.60 (*Z*), 69.24 (*E*) (CH), 70.26 (*Z*), 70.87 (*E*) (C), 112.47 (*E*), 112.83 (*Z*) (CH), 118.26 (*Z*), 118.69 (*E*) (C), 119.65 (*E*), 119.84 (*Z*) ($CH_2$), 121.74 (*E*), 121.91 (*Z*) (CH), 124.59 (*E*), 124.86 (*Z*) (C), 130.04 (*Z*), 130.80 (*E*), 131.87 (*Z*), 132.30 (*E*), 134.13 (*Z*), 134.45 (*E*) (CH), 158.32 (*Z*), 159.22 (*E*), 163.79 (*E*), 164.22 (*Z*) (C). MS (EI, 70 eV): *m*/*z*=302 ($M^+$, 25), 262 (100), 146 (9), 83 (69), 68 (10). Anal. Calcd for $C_{16}H_{18}N_2O_2S$: C, 63.55; H, 6.00; N, 9.26. Found: C, 63.24; H, 6.18; N, 9.07.

**3.2.25. 2-(1-Cyano-1-phenyl)methylidene-4-hydroxymethyl-3-methylthiazolidine (5l).** Starting with phenylacetonitrile (0.351 g, 3.0 mmol), *n*-butyllithium (4.2 mL, 6.6 mmol, 1.6 M), methylisothiocyanate (0.262 g, 3.0 mmol) and epibromohydrin (0.493 g, 3.6 mmol) in 15 mL of THF, **5l** was isolated as a yellow oil (0.302 g, 1.2 mmol, 41%, *E*/*Z*=3:1). IR (KBr): $\tilde{\nu}$=3413 (br s), 3098 (w), 3079 (m), 3056 (m), 3027 (m), 2939 (s), 2876 (m), 2176 (s), 1692 (w), 1645 (m), 1593 (s), 1569 (s), 1561 (s), 1491 (s), 1423 (s) cm$^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=310.76 (4.20) nm. $^1$H NMR ($CDCl_3$, 300 MHz): $\delta$=2.25 (br s, 1H, OH), 2.69 (s, 3H, $CH_3$, *Z*), 2.99–3.28 (m, 2H, $CH_2$, *E*, *Z*), 3.47 (s, 3H, $CH_3$, *E*), 3.80–3.99 (m, 3H, $CH_2$, CH, *E*, *Z*), 7.15–7.45 (m, 5H, CH, *E*, *Z*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=28.35 (*Z*), 28.58 (*E*) ($CH_2$), 37.36 (*E*), 39.76 (*Z*) ($CH_3$), 60.13 (*E*), 60.65 (*Z*) ($CH_2$), 70.25 (*E*) (C), 70.51 (*E*) (CH), 71.43 (*Z*) (C), 71.90 (*Z*) (CH), 121.45 (*E*), 123.65 (*Z*) (C), 125.47 (*Z*), 126.15 (*E*), 127.72 (*Z*), 127.92 (*E*), 128.13 (*Z*), 128.61 (*E*) (CH), 135.31 (*Z*), 126.33 (*E*), 161.45 (*Z*), 163.17 (*E*) (C). MS (EI, 70 eV): *m*/*z*=246 ($M^+$, 81), 215 (100), 200 (11), 174 (7), 159 (15). HRMS (FT-ICR): calcd for $C_{13}H_{15}N_2OS$ *m*/*z*=247.08996; found: *m*/*z*=247.09004±2 ppm.

**3.2.26. 2-(1-Cyano-1-phenyl)methylidene-4-hydroxymethyl-3-ethylthiazolidine (5m).** Starting with phenylacetonitrile (0.234 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), ethylisothiocyanate (0.174 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5m** was isolated as a colourless oil (0.388 g, 1.49 mmol, 75%, *E*/*Z*=3:1). IR (KBr): $\tilde{\nu}$=3427 (s), 3024 (w), 2970 (m), 2934 (m), 2873 (m), 2177 (s), 1692 (m), 1643 (s), 1598 (m), 1546 (s), 1490 (w), 1462 (m), 1445 (s) cm$^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=309.83 (4.05) nm. $^1$H NMR ($CDCl_3$, 300 MHz): $\delta$=0.89 (t, $^3J$=7 Hz, 3H, $CH_3$, *Z*), 1.34 (t, $^3J$=7 Hz, 3H, $CH_3$, *E*), 2.91–3.22 (m, 4H, $CH_2$, *E*, *Z*), 3.59–3.72 (m, 2H, $CH_2$, *E*, *Z*), 4.00–4.12 (m, 1H, CH, *E*, *Z*), 7.21–7.34 (m, 3H, CH, *E*, *Z*), 7.40–7.43 (m, 2H, CH, *E*, *Z*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=12.98 (*Z*), 13.94 (*E*) ($CH_3$), 29.87 (*E*), 29.88 (*Z*), 44.80 (*E*), 45.95 (*Z*), 61.14 (*E*), 61.60 (*Z*) ($CH_2$), 68.66 (*E*), 68.81 (*Z*) (CH), 72.83 (*E*), 75.37 (*Z*), 121.30 (*E*), 123.50 (*Z*) (C), 126.48 (*Z*), 126.99 (*E*), 128.33 (*Z*), 128.34 (*E*), 128.49 (*Z*), 129.45 (*E*) (CH), 134.11 (*Z*), 136.86 (*E*), 162.12 (*Z*), 163.14 (*E*) (C). MS (EI, 70 eV): *m*/*z*=260 ($M^+$, 100), 229 (86), 201 (57), 174 (20), 159 (10). HRMS (EI, 70 eV): calcd: *m*/*z*=260.0983 for $C_{14}H_{16}N_2OS$ ($M^+$); found: *m*/*z*=260.0983±2 ppm.

**3.2.27. 2-(1-Cyano-1-(4-tolyl))methylidene-4-hydroxymethyl-3-ethylthiazolidine (5n).** Starting with 4-tolylacetonitrile (0.262 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), ethylisothiocyanate (0.174 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5n** was isolated as a colourless oil (0.491 g, 1.79 mmol, 90%, *E*/*Z*=2:1). IR (KBr): $\tilde{\nu}$=3432 (s), 2975 (w), 2934 (m), 2873 (w), 2177 (s), 1645 (w), 1548 (s), 1464 (m), 1444 (m) cm$^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=307.35 (4.08) nm. $^1$H NMR (300 MHz, $CDCl_3$): $\delta$=$^1$H NMR (300 MHz, $CDCl_3$): $\delta$=0.85 (t, $^3J$=7 Hz, 3H, $CH_3$, *Z*), 1.27 (t, $^3J$=7 Hz, 3H, $CH_3$, *E*), 2.28 (s, 3H, $CH_3$, *Z*), 2.30 (s, 3H, $CH_3$, *E*), 2.94–3.22 (m, 2H, CH, $CH_2$, *E*, *Z*), 3.56–3.66 (m, 2H, $CH_2$, *E*, *Z*), 3.94–4.08 (m, 3H, $CH_2$, *E*, *Z*), 7.05–7.14 (m, 2H, CH, *E*, *Z*), 7.26–7.30 (m, 2H, CH, *E*, *Z*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=12.53 (*Z*), 13.43 (*E*), 20.74 (*E*), 21.89 (*Z*), ($CH_3$), 27.49 (*Z*), 29.39 (*E*), 43.93 (*E*), 45.15 (*Z*), 60.30 (*E*), 60.87 (*Z*), ($CH_2$), 68.48 (*Z*), 68.57 (*E*) (CH), 70.88 (*E*), 73.87 (*Z*), 121.24 (*E*), 123.47 (*Z*) (C), 127.87 (*E*), 128.75 (*Z*), 128.76 (*E*), 128.99 (*Z*) (CH), 130.62 (*Z*), 133.61 (*E*), 135.78 (*Z*), 136.29 (*E*), 161.23 (*Z*), 162.62 (*E*) (C). MS (EI, 70 eV): *m*/*z*=274 ($M^+$, 100), 243 (84), 215 (46), 188 (14), 119 (33). HRMS (EI, 70 eV): calcd: *m*/*z*=274.1140 for $C_{15}H_{18}N_2OS$ ($M^+$); found: *m*/*z*=274.1140±2 ppm.

**3.2.28. 2-(1-Cyano-1-(4-methoxyphenyl)methylidene-4-hydroxymethyl-3-ethylthiazolidine (5o).** Starting with (4-methoxyphenyl)acetonitrile (0.294 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), ethylisothiocyanate (0.174 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5o** was isolated as a colourless oil (0.514 g, 1.77 mmol, 89%, *E*/*Z*=3:1). IR (KBr): $\tilde{\nu}$=3428 (s), 2975 (s), 2935 (m), 2873 (m), 2840 (w), 2177 (s), 1640 (w), 1606 (m), 1549 (s), 1509 (s), 1463 (m), 1444 (m), 1415 (w) cm$^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=232.31 (4.05), 303.00 (4.16) nm. $^1$H NMR ($CDCl_3$, 300 MHz): $\delta$=0.84 (t, $^3J$=7 Hz, 3H, $CH_3$, *Z*), 1.32 (t, $^3J$=7 Hz, 3H, $CH_3$, *E*), 2.95–3.20 (m, 2H, $CH_2$, *E*, *Z*), 3.55–3.82 (m, 6H, CH, $CH_2$, $CH_3$, *E*, *Z*), 3.96–4.06 (m, 2H, $CH_2$, *E*, *Z*), 6.81–6.86 (m, 2H, CH, *E*, *Z*), 7.17 (dd, $^3J$=8 Hz, $^4J$=2 Hz, 2H, CH, *Z*), 7.29 (dd, $^3J$=8 Hz, $^4J$=2 Hz, 2H, CH, *E*). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$=12.52 (*Z*), 13.55 (*E*) ($CH_3$), 29.34 (*E*), 29.42 (*Z*), 43.80 (*E*), 44.87 (*Z*) ($CH_2$), 54.86 (*E*), 54.87 (*Z*) ($CH_3$), 60.35 (*E*), 60.86 (*Z*) ($CH_2$), 68.51 (*E*), 68.59 (*Z*) (CH), 70.23 (*E*), 73.48 (*Z*) (C), 113.49 (*E*), 113.54 (*Z*) (CH), 121.31 (*E*), 123.52 (*Z*), 125.73 (*Z*), 128.84 (*E*) (C), 129.41 (*Z*), 130.59 (*E*) (CH), 157.74 (*Z*), 158.17 (*E*), 160.83 (*Z*), 162.67 (*E*) (C). MS (EI, 70 eV): *m*/*z*=290 ($M^+$, 100), 275 (10), 259 (65), 231 (18), 216 (12). HRMS (EI, 70 eV): calcd: *m*/*z*=290.1089 for $C_{15}H_{18}N_2O_2S$ ($M^+$); found: *m*/*z*=290.1089±2 ppm.

**3.2.29. 2-(1-Cyano-1-(2-tolyl))methylidene-4-hydroxymethyl-3-ethylthiazolidine (5p).** Starting with 2-tolylacetonitrile (0.262 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), ethylisothiocyanate (0.174 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5p** was isolated as a colourless oil (0.393 g, 1.4 mmol, 72%, *E*/*Z*=3:1). IR (KBr): $\tilde{\nu}$=3413 (s), 3093 (m), 3063

(m), 3016 (m), 2972 (s), 2934 (s), 2873 (s), 2174 (s), 1644 (s), 1551 (s), 1483 (m), 1461 (s) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=294.94 (4.08) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=0.89 (t, $^3J$=7 Hz, 3H, $CH_3$, *Z*), 1.33 (t, $^3J$=7 Hz, 3H, $CH_3$, *E*), 2.12 (s, 3H, $CH_3$, *Z*), 2.34 (s, 3H, $CH_3$, *E*), 2.89–3.22 (m, 2H, $CH_2$, *E*, *Z*), 3.56–3.69 (m, 2H, $CH_2$, *E*, *Z*), 3.88–4.11 (m, 3H, $CH_2$, CH, *E*, *Z*), 7.12–7.25 (m, 4H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=12.46 (*Z*), 13.40 (*E*), 19.30 (*Z*), 19.54 (*E*) ($CH_3$), 29.17 (*E*), 29.47 (*Z*), 42.97 (*E*), 42.98 (*Z*), 60.26 (*E*), 60.46 (*Z*) ($CH_2$), 67.84 (*Z*) (CH), 68.03 (*E*) (C), 69.07 (*E*) (CH), 71.12 (*Z*), 120.48 (*E*), 120.49 (*Z*) (C), 125.72 (*E*), 125.78 (*Z*), 127.69 (*Z*), 128.09 (*E*), 129.96 (*E*), 130.25 (*Z*), 131.59 (*E*), 132.40 (*Z*) (CH), 135.40 (*E*), 136.58 (*Z*), 137.75 (*Z*), 138.04 (*E*), 162.45 (*Z*), 162.93 (*E*) (C). MS (EI, 70 eV): *m*/*z*=274 ($M^+$, 93), 243 (100), 198 (7), 188 (9), 173 (13). HRMS (EI, 70 eV): calcd: *m*/*z*=274.1140 for $C_{15}H_{18}N_2OS$ ($M^+$); found: *m*/*z*=274.1140±2 ppm.

**3.2.30. 2-(1-Cyano-1-(2-methoxyphenyl))methylidene-4-hydroxymethyl)-3-ethylthiazolidine (5q).** Starting with (2-methoxyphenyl)acetonitrile (0.294 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), ethylisothiocyanate (0.174 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5q** was isolated as a colourless oil (0.418 g, 0.14 mmol, 72%, *E*/*Z*=2:1). IR (KBr): $\tilde{\nu}$=3431 (s), 3074 (w), 2976 (m), 2933 (m), 2871 (m), 2175 (s), 1652 (m), 1596 (m), 1551 (s), 1489 (m), 1458 (s), 1440 (s) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=286.42 (4.07), 302.59 (4.07) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=0.81 (t, $^3J$=7 Hz, 3H, $CH_3$, *E*), 1.35 (t, $^3J$=7 Hz, 3H, $CH_3$, *Z*), 2.70 (q, $^3J$=7 Hz, 2H, $CH_2$, *E*), 2.86 (q, $^3J$=7 Hz, 2H, $CH_2$, *Z*), 3.09 (dd, $^3J$=7 Hz, $^2J$=18 Hz, 1H, $CH_2$, *E*), 3.10 (dd, $^3J$=7 Hz, $^2J$=18 Hz, 1H, $CH_2$, *Z*), 3.26 (dd, $^3J$=11 Hz, $^2J$=18 Hz, 1H, $CH_2$, *E*), 3.27 (dd, $^3J$=11 Hz, $^2J$=18 Hz, 1H, $CH_2$, Z), 3.45–3.78 (m, 2H, $CH_2$, *E*, *Z*), 3.80 (s, 3H, $CH_3$, *E*), 3.84 (s, 3H, $CH_3$, *Z*), 3.98–4.06 (m, 1H, CH, *E*, *Z*), 6.85–6.96 (m, 2H, CH, *E*, *Z*), 7.17–7.31 (m, 2H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=14.06 (*E*), 14.90 (*Z*) ($CH_3$), 30.04 (*E*), 30.22 (*Z*), 44.70 (*E*), 44.98 (*Z*) ($CH_2$), 56.21 (*E*), 56.79 (*Z*) ($CH_3$), 61.91 (*E*), 62.30 (*Z*) ($CH_2$), 69.36 (*E*), 69.73 (*Z*) (CH), 76.28 (*E*), 77.48 (*Z*) (C), 111.08 (*Z*), 111.45 (*E*), 120.92 (*E*), 121.25 (*Z*) (CH), 123.12 (*Z*), 123.30 (*E*), 124.87 (*Z*), 125.37 (*E*) (C), 129.27 (*Z*), 129.61 (*E*), 131.03 (*Z*), 131.39 (*E*) (CH), 156.83 (*Z*), 157.73 (*E*), 162.67 (*E*), 163.31 (*Z*). MS (EI, 70 eV): *m*/*z*=290 ($M^+$, 100), 259 (67), 231 (20), 216 (13), 135 (71). HRMS (EI, 70 eV): calcd: *m*/*z*=290.1089 for $C_{15}H_{18}N_2O_2S$ ($M^+$); found: *m*/*z*=290.1089±2 ppm.

**3.2.31. 2-(1-Cyano-1-phenyl)methylidene-4-hydroxymethyl-3-propylthiazolidine (5r).** Starting with phenylacetonitrile (0.351 g, 3.0 mmol), *n*-butyllithium (4.2 mL, 6.6 mmol, 1.6 M), *n*-propylisothiocyanate (0.304 g, 3.0 mmol) and epibromohydrin (0.493 g, 3.6 mmol) in 15 mL of THF, **5r** was isolated as a yellow oil (0.549 g, 2.0 mmol, 67%, *E*/*Z*=3:1). IR (KBr): $\tilde{\nu}$=3424 (s), 3080 (w), 3058 (w), 2964 (m), 2935 (m), 2875 (w), 2172 (s), 1692 (w), 1644 (m), 1596 (w), 1544 (s), 1491 (m), 1463 (m), 1442 (m) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)= 309.07 (4.06) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=0.50 (t, $^3J$=8 Hz, 3H, $CH_3$, *Z*), 0.96 (t, $^3J$=8 Hz, 3H, $CH_3$, *E*), 1.28 (tq, $^3J$=8 Hz, 2H, $CH_2$, *Z*), 1.77 (tq, $^3J$=8 Hz, 2H, $CH_2$, *E*), 2.85–3.47 (m, 4H, $CH_2$, *E*, *Z*), 3.60–3.72 (m, 2H, $CH_2$, *E*, *Z*), 3.96–4.08 (m, 1H, CH, *E*, *Z*), 7.15–7.31 (m, 3H, CH, *E*, *Z*), 7.38–7.42 (m, 2H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=10.30 (*Z*), 10.39 (*E*) ($CH_3$), 20.52 (*Z*), 21.26 (*E*), 29.09 (*Z*), 29.24 (*E*), 50.59 (*E*), 51.92 (*Z*), 60.22 (*E*), 60.79 (*Z*) ($CH_2$), 69.03 (*E*), 69.35 (*Z*) (CH), 70.96 (*E*), 73.15 (*Z*), 121.22 (*E*), 123.65 (*Z*) (C), 126.15 (*Z*), 126.54 (*E*), 128.10 (*E*), 128.31 (*Z*), 129.15 (*Z*), 129.16 (*E*) (CH), 133.64 (*Z*), 136.69 (*E*), 161.33 (*Z*), 162.69 (*E*) (C). MS (EI, 70 eV): *m*/*z*=274 ($M^+$, 24), 200 (23), 143 (30), 129 (65), 101 (87), 86 (100). HRMS (EI, 70 eV): calcd: *m*/*z*=274.1140 for $C_{15}H_{18}N_2OS$ [$M^+$]; found: *m*/*z*= 274.1140±2 ppm.

**3.2.32. 2-(1-Cyano-1-phenyl)methylidene-4-hydroxymethyl-3-butylthiazolidine (5s).** Starting with phenylacetonitrile (0.351 g, 3.0 mmol), *n*-butyllithium (4.2 mL, 6.6 mmol, 1.6 M), *n*-butylisothiocyanate (0.346 g, 3.0 mmol) and epibromohydrin (0.493 g, 3.6 mmol) in 15 mL of THF, **5s** was isolated as a yellow oil (0.607 g, 2.1 mmol, 70%, *E*/*Z*=3:1). IR (KBr): $\tilde{\nu}$=3421 (s), 3078 (w), 3056 (w), 3025 (w), 2959 (s), 2933 (s), 2871 (m), 2177 (s), 1691 (m), 1646 (w), 1596 (w), 1548 (s), 1492 (m), 1463 (s), 1443 (s) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=310.68 (4.06) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=0.64 (t, $^3J$=7 Hz, 3H, $CH_3$, *Z*), 0.96 (t, $^3J$=7 Hz, 3H, $CH_3$, *E*), 0.89 (quin, $^3J$=7 Hz, 2H, $CH_2$, *E*), 1.26 (quin, $^3J$=7 Hz, 2H, $CH_2$, *E*), 1.37 (quin, $^3J$=7 Hz, 2H, $CH_2$, *E*), 1.72 (quin, $^3J$=7 Hz, 2H, $CH_2$, *E*), 2.90–3.24 (m, 3H, $CH_2$, *E*, *Z*), 3.40–3.69 (m, 3H, $CH_2$, *E*, *Z*), 3.95–4.14 (m, 1H, CH, *E*, *Z*), 7.12–7.31 (m, 4H, CH, *E*, *Z*), 7.33–7.42 (m, 1H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=13.38 (*Z*), 13.89 (*E*) ($CH_3$), 19.36 (*Z*), 19.61 (*E*), 29.46 (*E*), 29.51 (*Z*), 29.56 (*E*), 30.26 (*Z*), 49.24 (*E*), 50.45 (*Z*), 60.56 (*E*), 61.11 (*Z*) ($CH_2$), 69.19 (*E*), 69.55 (*Z*) (CH), 71.45 (*E*), 73.55 (*Z*), 121.51 (*E*), 123.94 (*Z*) (C), 126.44 (*Z*), 126.83 (*E*), 128.41 (*E*), 128.62 (*Z*), 129.30 (*Z*), 129.45 (*E*) (CH), 134.01 (*Z*), 136.99 (*E*), 161.67 (*Z*), 163.01 (*E*) (C). MS (EI, 70 eV): *m*/*z*=288 ($M^+$, 100), 256 (19), 200 (85), 175 (24), 143 (17). HRMS (EI, 70 eV): calcd: *m*/*z*=288.1296 for $C_{16}H_{20}N_2OS$ [$M^+$]; found: *m*/*z*=288.1296±2 ppm.

**3.2.33. 2-(1-Cyano-1-phenyl)methylidene-4-hydroxymethyl-3-isobutylthiazolidine (5t).** Starting with phenylacetonitrile (0.351 g, 3.0 mmol), *n*-butyllithium (4.2 mL, 6.6 mmol, 1.6 M), *iso*-butylisothiocyanate (0.346 g, 3.0 mmol) and epibromohydrin (0.493 g, 3.6 mmol) in 15 mL of THF, **5t** was isolated as a yellow oil (0.582 g, 2.0 mmol, 67%, *E*/*Z*=5:1). IR (KBr): $\tilde{\nu}$=3425 (s), 3078 (w), 3057 (m), 3023 (w), 2959 (s), 2872 (s), 2234 (m), 2175 (s), 1676 (w), 1645 (w), 1623 (w), 1596 (m), 1552 (s), 1532 (s), 1493 (s), 1463 (s), 1443 (s) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=309.70 (4.03) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=0.68 (d, $^3J$=7 Hz, 6H, $CH_3$, *Z*), 0.98 (d, $^3J$=7 Hz, 6H, $CH_3$, *E*), 1.46–1.73 (m, 1H, CH, *E*, *Z*), 1.86–1.95 (m, 2H, $CH_2$, Z), 2.22–2.31 (m, 2H, $CH_2$, *E*), 2.63–3.41 (m, 3H, $CH_2$, *E*, *Z*), 3.60–3.71 (m, 1H, $CH_2$, *E*, *Z*), 3.97–4.10 (m, 1H, CH, *E*, *Z*), 7.13–7.42 (m, 5H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=19.19 (*E*), 19.74 (*Z*) ($CH_3$), 26.75 (*Z*), 26.87 (*E*) (CH), 28.82 (*Z*), 29.05 (*E*) ($CH_2$), 55.93 (*E*), 57.69 (*Z*), 60.32 (*E*), 60.50 (*Z*) ($CH_2$), 70.10 (*E*), 70.87 (*Z*) (CH), 71.25 (*E*), 72.79 (*Z*), 120.75 (*Z*), 121.49 (*E*) (C), 126.42 (*E*), 126.84 (*Z*), 128.30 (*Z*),

128.41 (*E*), 129.40 (*Z*), 129.51 (*E*) (CH), 135.68 (*Z*), 137.02 (*E*), 160.31 (*Z*), 162.05 (*E*) (C). MS (EI, 70 eV): *m*/*z*=288 ($M^+$, 100), 233 (32), 201 (69), 175 (69), 143 (19). HRMS (FT-ICR): Calcd for $C_{16}H_{21}N_2OS$ *m*/*z*=289.13691; found: *m*/*z*=289.13720±2 ppm. Anal. Calcd for $C_{16}H_{20}N_2OS$: C, 66.63; H, 6.99; N, 9.71. Found: C, 66.53; H, 6.94; N, 9.32.

**3.2.34. 2-(1-Cyano-1-(2-thiophenyl))methylidene-4-hydroxymethyl-3-phenylthiazolidine (5u).** Starting with 2-thiophenylacetonitrile (0.380 g, 3.0 mmol), *n*-butyllithium (4.2 mL, 6.6 mmol, 1.6 M), phenylisothiocyanate (0.405 g, 3.0 mmol) and epibromohydrin (0.420 g, 3.1 mmol) in 15 mL of THF, **5u** was isolated as a colourless solid (0.656 g, 2.1 mmol, 70%, *Z*/*E*=5:1). IR (KBr): $\tilde{\nu}$=3454 (s), 2184 (s), 1592 (w), 1549 (s), 1516 (s), 1494 (m), 1430 (w) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=246.17 (4.00), 279.43 (4.04), 345.92 (4.05) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=3.27 (dd, $^2J$=12 Hz, $^3J$=5 Hz, 1H, $CH_2$, *E*), 3.37 (dd, $^2J$=12 Hz, $^3J$=7 Hz, 1H, $CH_2$, *Z*), 3.72 (d, $^3J$=7 Hz, 1H, $CH_2$, *Z*), 3.74 (d, $^3J$=5 Hz, 1H, $CH_2$, *E*), 4.27 (dddd, $^3J$=5 Hz, $^3J$=7 Hz, 1H, CH, *Z*), 4.45–4.51 (m, 1H, CH, *E*) 6.96 (d, $^3J$=4 Hz, $^4J$=1 Hz, 1H, CH, *E*), 6.98 (d, $^3J$=5 Hz, $^4J$=1 Hz, 1H, CH, *Z*), 7.06 (dd, $^3J$=4 Hz, $^4J$=1 Hz, 1H, CH, *Z*), 7.22 (dd, $^3J$=5 Hz, $^4J$=1 Hz, 1H, CH, *Z*), 7.29–7.34 (m, 3H, CH, *Z*, *E*), 7.41–7.43 (m, 2H, CH, *Z*+*E*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=29.47 (*E*), 30.30 (*Z*), 60.02 (*Z*), 60.51 (*E*) ($CH_2$), 70.38 (*Z*), 72.34 (*E*) (CH), 72.62 (*Z*), 72.63 (*E*), 116.90 (*Z*), 120.10 (*E*) (C), 121.63 (*Z*), 123.72 (*E*), 124.09 (*Z*), 124.27 (*E*), 125.33 (*E*), 125.50 (*Z*), 125.58 (*E*), 125.70 (*Z*), 126.18 (*Z*), 126.65 (*E*), 127.82 (*E*), 128.69 (*Z*) (CH), 133.77 (*E*), 137.49 (*Z*), 141.03 (*Z*), 141.04 (*E*), 158.24 (*E*), 162.17 (*Z*) (C). MS (EI, 70 eV): *m*/*z*=314 ($M^+$, 6), 283 (5), 84 (13), 77 (7), 28 (100). Anal. Calcd for $C_{16}H_{14}N_2O_2S_2$: C, 61.12; H, 4.49; N, 8.91. Found: C, 61.34; H, 4.17; N, 9.03.

**3.2.35. 2-(1-Cyano-1-(2-thiophenyl))methylidene-4-hydroxymethyl-3-allylthiazolidine (5v).** Starting with 2-thiophenylacetonitrile (0.246 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), allylisothiocyanate (0.198 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5v** was isolated as a colourless solid (0.373 g, 1.3 mmol, 67%, *Z*/*E*=5:1). Mp 99 °C. IR (KBr): $\tilde{\nu}$=3401 (s), 2943 (w), 2179 (s), 1546 (s), 1519 (s), 1436 (w) $cm^{-1}$. UV–VIS (MeCN): $\lambda_{max}$ (log $\varepsilon$)=240.21 (4.00), 310.29 (4.02) nm. $^1H$ NMR ($CDCl_3$, 300 MHz): $\delta$=2.99–3.24 (m, 3H, $CH_2$, *E*, *Z*), 3.67–3.71 (m, 2H, $CH_2$, *E*, *Z*), 4.04–4.12 (m, 1H, CH, *E*, *Z*), 4.19 (dd, $^3J$=6 Hz, $^4J$=2 Hz, 1H, CH, *E*), 4.63 (dd, $^3J$=6 Hz, $^4J$=2 Hz, 1H, CH, *Z*), 5.03–5.17 (m, 1H, CH, *Z*), 5.27–5.39 (m, 1H, CH, *Z*), 5.52–5.64 (m, 2H, CH, *E*), 5.87–6.00 (m, 2H, CH, *Z*), 6.89–6.97 (m, 1H, CH, *E*, *Z*), 7.02 (dd, $^3J$=4 Hz, 1H, CH, *E*, *Z*), 7.21–7.24 (m, 1H, CH, *E*, *Z*). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$=29.04 (*E*), 29.05 (*Z*), 51.43 (*Z*), 52.13 (*E*), 59.94 (*Z*), 60.17 (*E*) ($CH_2$), 66.11 (*Z*), 66.12 (*E*) (C), 67.63 (*E*), 68.01 (*Z*) (CH), 117.65 (*Z*), 117.99 (*E*) ($CH_2$), 119.28 (*Z*), 121.15 (*E*) (C), 124.28 (*Z*), 124.90 (*E*), 126.00 (*Z*), 126.10 (*E*), 126.39 (*Z*), 126.80 (*E*), 131.07 (*E*), 131.40 (*Z*) (CH), 134.38 (*E*), 137.88 (*Z*), 162.69 (*E*), 163.42 (*Z*) (C). MS (EI, 70 eV) *m*/*z*=278 ($M^+$, 40), 238 (60), 207 (68), 180 (17), 146 (38), 41 (100). HRMS (EI, 70 eV): calcd: *m*/*z*=278.0548 for $C_{13}H_{14}N_2OS_2$ [$M^+$]; found: *m*/*z*=278.0548±2 ppm.

**3.2.36. 2-(1-Cyano-1-(2-thiophenyl))methylidene-4-hydroxymethyl-3-ethylthiazolidine (5w).** Starting with 2-thiophenylacetonitrile (0.246 g, 2.0 mmol), *n*-butyllithium (2.8 mL, 4.4 mmol, 1.6 M), ethylisothiocyanate (0.174 g, 2.0 mmol) and epibromohydrin (0.274 g, 2.0 mmol) in 10 mL of THF, **5w** was isolated as a colourless solid (0.339 g, 1.2 mmol, 64%, *Z*/*E*=5:1). IR (KBr): $\tilde{\nu}$=3452 (s), 2923 (w), 2186 (s), 1594 (w), 1537 (s), 1490 (s), 1444 (w) $cm^{-1}$. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$=0.97 (t, $^3J$=7 Hz, 3H, $CH_3$, *E*), 1.34 (t, $^3J$=7 Hz, 3H, $CH_3$, *Z*), 2.89–2.91 (m, 1H, CH, *E*, *Z*), 3.04–3.22 (m, 2H, $CH_2$, *E*, *Z*), 3.58–3.73 (m, 2H, $CH_2$, *E*, *Z*), 4.03–4.11 (m, 2H, $CH_2$, *E*, *Z*), 6.86 (dd, $^3J$=4 Hz, $^4J$=1 Hz, 1H, CH, *E*), 6.90–6.92 (m, 1H, CH, *E*), 6.96 (dd, $^3J$=4 Hz, $^4J$=1 Hz, 1H, CH, *E*), 6.99 (dd, $^3J$=4 Hz, $^4J$=1 Hz, 1H, CH, *Z*), 7.20 (dd, $^3J$=4 Hz, $^4J$=1 Hz, 1H, CH, *Z*), 7.21 (dd, $^3J$=4 Hz, $^4J$=1 Hz, 1H, CH, *E*). $^{13}C$ NMR (150 MHz, $CDCl_3$): $\delta$=14.05 (*E*), 14.15 (*Z*), ($CH_3$), 30.13 (*E*), 30.22 (*Z*), 44.75 (*Z*), 45.29 (*E*), 61.16 (*Z*), 61.33 (*E*) ($CH_2$), 65.86 (*Z*), 65.87 (*E*) (C), 69.15 (*E*), 69.35 (*Z*) (CH), 120.53 (*Z*), 122.34 (*E*) (C), 125.37 (*Z*), 125.93 (*E*), 127.07 (*Z*), 127.12 (*E*), 127.57 (*Z*), 127.87 (*E*) (CH), 136.73 (*E*), 139.23 (*Z*), 162.62 (*E*), 164.34 (*Z*) (C). Anal. Calcd for $C_{12}H_{14}N_2OS_2$: C, 54.11; H, 5.30; N, 10.52. Found: C, 53.78; H, 4.97; N, 10.33.

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## References and notes

1. For a review of cyclization reactions of dianions, see: Langer, P.; Freiberg, W. *Chem. Rev.* **2004**, *104*, 4125.
2. Langer, P.; Freifeld, I. *Chem.—Eur. J.* **2001**, *7*, 565.
3. Freifeld, I.; Armbrust, H.; Langer, P. *Synthesis* **2006**, *71*, 2293.
4. (a) Albrecht, U.; Gerwien, K.; Langer, P. *Tetrahedron Lett.* **2005**, *46*, 1017; (b) Dang, T. T.; Albrecht, U.; Gerwien, K.; Siebert, M.; Langer, P. *J. Org. Chem.*, in press.
5. Langer, P.; Armbrust, H.; Eckardt, T.; Magull, J. *Chem.—Eur. J.* **2002**, *8*, 1443.
6. Langer, P.; Freifeld, I. *Org. Lett.* **2001**, *2*, 3903.
7. (a) Grangier, G.; Aitken, D. J.; Guillaume, D.; Husson, H.-P. *Tetrahedron Lett.* **1994**, *35*, 4355; (b) Benedetti, F.; Calcdti, F.; Risaliti, A. *Tetrahedron Lett.* **1993**, *34*, 6443; (c) Aitken, D. J.; Royer, J.; Husson, H.-P. *J. Org. Chem.* **1990**, *55*, 2814; (d) Aitken, D. J.; Royer, J.; Husson, H.-P. *Tetrahedron Lett.* **1988**, *29*, 3315; (e) Mouzin, G.; Cousse, H.; Bonnaud, H. *Synthesis* **1978**, 304.
8. Albrecht, U.; Langer, P. *Synlett* **2004**, 2200.
9. The term dianions is used although dilithiated nitriles mostly reside as a monolithio compound with an associated molecule of the base. For a review of the structure of lithiated nitriles and sulfones, see: Boche, G. *Angew. Chem.* **1989**, *101*, 286; *Angew. Chem., Int. Ed. Engl.* **1989**, *28*, 277.
10. For cyclization reactions of 1,1-dianions, see: (a) Müller, J. F. K.; Neuburger, M.; Zehnder, M. *Helv. Chim. Acta*

**1997**, *80*, 2182; (b) Eisch, J. J.; Dua, S. K.; Behrooz, M. *J. Org. Chem.* **1985**, *50*, 3674; (c) Mussatto, M. C.; Savoia, D.; Trombini, C.; Umani-Ronchi, A. *J. Chem. Soc., Perkin Trans. 1* **1980**, 260.

11. (a) Houben-Weyl. Methoden der Organischen Chemie. Carbocyclic Three-Membered Ring Compounds; de Meijere, A., Ed.; 4th ed.; Thieme: Stuttgart, Germany, 1996; Vol. E17; (b) *The Chemistry of the Cyclopropyl Group*; Rappoport, Z., Ed.; Wiley: Chichester, UK, 1987.
12. For the preparation of cyclopropanes by reaction of silyl/sulfur-stabilized carbanions with epoxides, see: Schaumann, E.; Friese, C. *Tetrahedron Lett.* **1989**, *30*, 7033.
13. For the synthesis and reactions of silyl-substituted cyclopropanes, see: (a) Paquette, L. A.; Blankenship, C.; Wells, G. J. *J. Am. Chem. Soc.* **1984**, *106*, 6442; (b) Wells, G. J.; Yan, T.-H.; Paquette, L. A. *J. Org. Chem.* **1984**, *49*, 3604; (c) Blankenship, C.; Wells, G. J.; Paquette, L. A. *Tetrahedron* **1988**, *44*, 4023.
14. (a) Khattak, I.; Ketcham, R.; Schaumann, E.; Adiwidjaja, G. *J. Org. Chem.* **1985**, *50*, 3431; for one-pot reactions of allenyl isothiocyanates, see: (b) Banert, K.; Hückstädt, H.; Vrobel, K. *Angew. Chem.* **1992**, *104*, 72; *Angew. Chem., Int. Ed. Engl.* **1992**, *31*, 90.
15. (a) Bukowski, L. *Pharmazie* **2001**, *56*, 23; (b) Rudorf, W.-D. *Tetrahedron* **1978**, *34*, 725.
16. Albrecht, U.; Gördes, D.; Schmidt, E.; Thurow, K.; Lalk, M.; Langer, P. *Bioorg. Med. Chem.* **2005**, *13*, 4402.
17. Bhattia, S. H.; Davies, G. M.; Hitchcock, P. B.; Loakes, D.; Young, D. W. *J. Chem. Soc., Perkin Trans. 1* **1999**, 2449.
18. (a) Capps, N. K.; Davies, G. M.; Loakes, D.; McCabe, R. W.; Young, D. W. *J. Chem. Soc., Perkin Trans. 1* **1991**, 3077; (b) Confalone, P. N.; Pizzalato, G.; Baggiolini, E. G.; Lollar, D.; Uskokovic, M. R. *J. Am. Chem. Soc.* **1975**, *97*, 5936; (c) Barco, A.; Benetti, S.; Casolari, A.; Pollini, G. P.; Spalluto, G. *Tetrahedron Lett.* **1990**, *31*, 4917; (d) Yanagida, M.; Hashimoto, K.; Ishida, M.; Shinozaki, H.; Shirahama, H. *Tetrahedron Lett.* **1989**, *30*, 3799.
19. Clough, S. C.; Solomon, R.; Crews, E.; Jaques, L.; Johnson, A.; Forehand, J. *J. Heterocycl. Chem.* **1982**, *19*, 1489.
20. Bachi, M. D.; Goldcalcdg, O.; Gross, A.; Vaya, J. *J. Org. Chem.* **1989**, *45*, 1481.
21. Evers, R.; Michalik, M. *J. Prakt. Chem.* **1991**, *333*, 699.
22. (a) Confalone, P. N.; Pizzolato, G.; Baggiolini, E. G.; Lollar, D.; Uskokovic, M. R. *J. Am. Chem. Soc.* **1977**, *99*, 7020; (b) Takata, T.; Tamura, Y.; Ando, W. *Tetrahedron* **1985**, *41*, 2135.
23. Hoppe, D. *Liebigs Ann. Chem.* **1976**, 2185.
24. Yoo, D.; Oh, J. S.; Lee, D.-W.; Kim, Y. G. *J. Org. Chem.* **2003**, *68*, 2979.
25. Capps, N. K.; Davies, G. M.; Loakes, D.; Young, D. W. *Tetrahedron* **1992**, *48*, 10149.
26. Crystallographic data (excluding structure factors) for the structure in this paper have been deposited to the Cambridge Crystallographic Data Centre as supplementary publication no. CCDC-297878. Copies of these data can be obtained, free of charge, on application to CCDC, 12 Union Road, Cambridge CB2 1EZ, UK; fax: +44(1223)336033 or e-mail: deposit@ccdc.cam.ac.uk) or via www.ccdc.cam.ac.uk/conts/retrieving.html.