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Synthesis of functionalized biphenyl-*C*-nucleosides and their incorporation into oligodeoxynucleotides

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Dedicated to Bernd Giese in appreciation of his creative contributions to radical chemistry.

Abstract—We describe the synthesis of eight novel *C*-nucleosides in which the nucleobases are replaced by biphenyl residues that carry one or two electron donor (–OCH_3, –NH_2) or acceptor (–NO_2) functional groups in the distal ring. These *C*-nucleosides were synthesized convergently and in high yields from a common bromophenyl-*C*-nucleoside precursor via Suzuki coupling with the respective boronic acids or esters. These nucleosides were subsequently converted into the corresponding phosphoramidite building blocks and efficiently incorporated into oligodeoxynucleotides by standard phosphoramidite chemistry.

1. Introduction

C-nucleosides are a class of compounds characterized by the replacement of the acid labile C–N glycosidic bond by a stable C–C bond. Many of them possess antiviral and antineoplastic activities and are thus of interest in medicinal chemistry.[1] In the context of nucleic acids, *C*-nucleosides bearing simple aromatic groups as nucleobase surrogates have recently been of interest to determine the energetic contribution of base-stacking to double helix stability,[2] to determine complementary base insertion fidelity of DNA polymerases,[3] as tools in DNA-based diagnostics,[4] and as novel orthogonal DNA base-pairs for the extension of the genetic alphabet.[5]

In our own research directed to exploit interstrand aromatic interactions for producing novel and functional DNA duplex architectures we recently found that up to seven biphenyl *C*-nucleotide-pairs can be accommodated in the center of a helix without breakdown of duplex stability.[6] To investigate the influence of the π-electron density of the biphenyl residues on duplex stability and on electron or charge transport properties through the corresponding base stack,[7] we set out to prepare a series of biphenyl *C*-nucleosides with electron-donating or electron-withdrawing groups in the distal phenyl ring. Here, we describe the synthesis and the incorporation into oligodeoxynucleotides of a series of novel, methoxy, nitro- or amino-modified biphenyl-*C*-nucleosides.

2. Results and discussion

In our synthesis we followed a highly convergent strategy starting from a common phenyl *C*-nucleoside precursor, to which the modified second phenyl ring is introduced via Suzuki coupling with suitably substituted phenyl-boronic acids or esters. Parallel to our work, Hocek et al. worked out a similar synthesis to access different biarylic nucleosides.[8] The advantage of our synthesis is the diastereoselective access to the intermediate for Suzuki coupling. The drawback of both strategies is the relatively poor yield in the glycosidic bond formation reaction leading to the respective intermediates.

The synthesis of key-intermediate **3b** followed established routes in *C*-glycoside chemistry (Scheme 1). 2′-deoxy-ribonolactone **2** was synthesized starting from 2′-deoxy-D-ribose following a protocol by Woski.[9] Oxidation with bromine in water[10] followed by protection with *tert*-butyldimethylchlorosilane (TBS-Cl) in the presence of imidazole in DMF[11] afforded the

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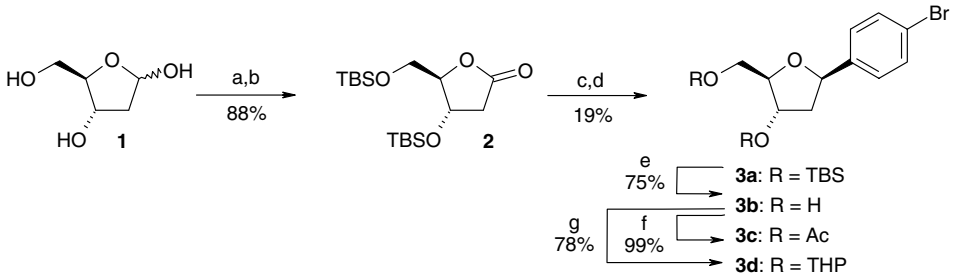


Scheme 1. Reagents and conditions: (a) Br_2, H_2O, rt, 5 d; (b) TBS-Cl, imidazole, DMF, rt, 16 h; (c) 1,4-dibromo-benzene, *n*-BuLi, THF, −78 °C, 30 min, then **2** in THF, −78 °C, 1 h; (d) Et_3SiH, $BF_3{\cdot}OEt_2$, CH_2Cl_2, −78 °C, 6 h; (e) TBAF, AcOH, THF, −10° → rt, 16 h; (f) Ac_2O, DMAP, pyridine, rt, 16 h; (g) DHP, Tos-OH, THF, rt, 16 h.

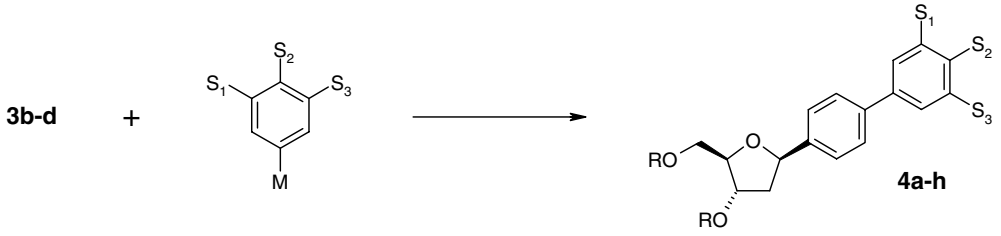
2′-deoxy-D-ribonolactone **2** in good yield. Lithiation of 1,4-dibromo-benzene with *n*-BuLi followed by the addition to lactone **2** resulted in the intermediate formation of the corresponding hemiacetals which, upon reduction with Et_3SiH in the presence of a strong Lewis acid ($BF_3{\cdot}Et_2O$), afforded the protected bromophenyl nucleoside **3a**, although in relatively poor yield. Only the β-anomer is formed (confirmed by ^1H NMR-NOE-spectroscopy). TBS-nucleoside **3a** was deprotected using standard conditions and leads to *C*-nucleoside **3b**. To enhance solubility and to simplify purification after Suzuki coupling, compound **3b** was protected with acetate or THP to yield **3c** and **3d**, respectively.

For the Suzuki coupling (Table 1) with the commercially available and suitably substituted phenyl-boronic acids, the mild conditions of Buchwald[12] were employed which yielded the biphenylic nucleosides **4c**–**f** and **4h** in high yield. This method is very effective already at room temperature and provides excellent results independent of the electronic properties of the substituents in the aryl-boronic acids. If the desired phenyl-boronic acid was not available, the corresponding phenyl-pinacolboronate[13] was synthesized and coupled classically using $Pd(PPh_3)_4$ in DMF at 85 °C. In this case, the yields were lower compared to the results obtained with the Buchwald method.

To have access to the amino biphenyl *C*-nucleosides, the THP-protected nitro-biphenyl-compounds **4g** and **4h** were converted to the Fmoc-amino-derivatives **5a** and **5b** using catalytic hydrogenation followed by Fmoc-protection[14] (Table 2). Deprotection of acetyl or THP, respectively, followed by standard tritylation and formation of the phosphoramidite lead to compounds **6a**–**h** in high yields (Table 3).

Automated oligodeoxynucleotide synthesis was performed on a 1 μmol scale on a DNA synthesizer using commercially available deoxynucleoside phosphoramidites and solid supports. A standard synthesis cycle with conventional detritylation, oxidation, and capping reagents was used. 5-(ethylthio)-1*H*-tetrazole (0.2 M in CH_3CN) was used as activator. Phosphoramidites **4a**–**f** were coupled as 0.1 M solutions in CH_3CN for 6 min. Coupling efficiency for the modified phosphoramidites was >95% as judged from trityl assay. Oligonucleotides were deprotected and detached from solid support by standard procedures (concd. NH_3, 55 °C, 16 h), purified by RP-HPLC, and characterized by ESI^- mass

Table 1. Conditions for biaryl bond formation (Suzuki coupling)

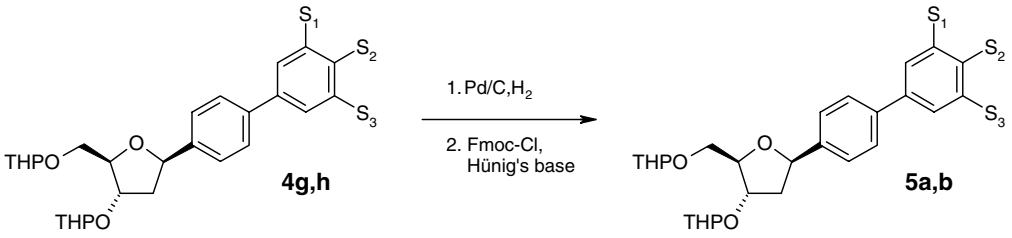


Entry	Starting material	S_1	S_2	S_3	M[a]	Exp. cond.[b]	Prod.	R	Yield (%)
1	**3b**	NO_2	H	NO_2	Bpin	i, ii	**4a**	Ac	41
2	**3b**	H	NO_2	H	Bpin	i, ii	**4b**	Ac	82
3	**3c**	OMe	H	H	$B(OH)_2$	iv	**4c**	Ac	94
4	**3c**	H	OMe	H	$B(OH)_2$	iv	**4d**	Ac	95
5	**3c**	OMe	OMe	H	$B(OH)_2$	iv	**4e**	Ac	93
6	**3c**	NO_2	H	H	$B(OH)_2$	iv	**4f**	Ac	97
7	**3b**	H	NO_2	H	Bpin	i, iii	**4g**	THP	65
8	**3d**	NO_2	H	H	$B(OH)_2$	iv	**4h**	THP	80

[a] Bpin: pinacolboronate.

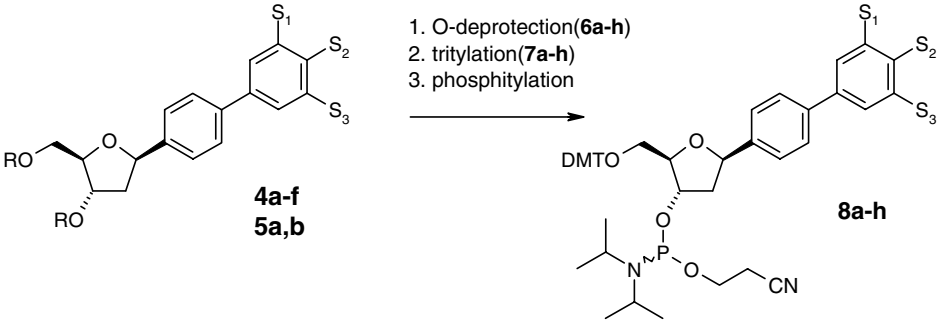
[b] (i) $Pd(PPh_3)_4$, K_3PO_4, DMF, 85 °C, 16 h; (ii) Ac_2O, DMAP, pyridine, rt, 16 h; (iii) DHP, Tos-OH, rt, 16 h; (iv) $Pd(OAc)_2$, 2-(di-*tert*-butyl-phosphino)-biphenyl, KF, THF, rt, 16 h.

Table 2. Synthesis of aminobiphenyl nucleosides



Entry	Starting material	S_1	S_2	S_3	Prod.	S_1	S_2	S_3	Yield (%)
1	**4g**	H	NO_2	H	**5a**	H	NHFmoc	H	67
2	**4h**	NO_2	H	H	**5b**	NHFmoc	H	H	64

Table 3. Synthesis of phosphoramidites



Entry	Starting material	S_1	S_2	S_3	R	Exp. cond.[a]	Prod.	Yield[b] (%)
1	**4a**	NO_2	H	NO_2	Ac	i, ii, iii	**8a**	70
1	**4b**	H	NO_2	H	Ac	i, ii, iv	**8b**	65
1	**4c**	OMe	H	H	Ac	i, ii, iv	**8c**	73
1	**4d**	H	OMe	H	Ac	i, ii, iv	**8d**	54
1	**4e**	OMe	OMe	H	Ac	i, ii, iv	**8e**	70
1	**4f**	NO_2	H	H	Ac	i, ii, iv	**8f**	70
1	**5a**	H	NHFmoc	H	THP	v, ii, iv	**8g**	48
1	**5b**	NHFmoc	H	H	THP	v, ii, iii	**8h**	75

[a] (i) K_2CO_3, MeOH/CH_2Cl_2, rt, 16 h; (ii) DMT-Cl, pyridine, rt, 4 h; (iii) *N*,*N*,*N*′,*N*′-tetraisopropyl-phosphordiamidite, diisopropylammonium-1*H*-tetrazo-1-ide, CH_2Cl_2, rt, 16 h; (iv) CEP-Cl, THF, rt, 2 h; (v) Tos-OH, MeOH/CH_2Cl_2, rt, 16 h.
[b] Over three steps.

spectrometry. In this way we prepared the 18 oligodeoxynucleotides listed in Table 4. In all cases we isolated the oligonucleotides in good yields and found the measured masses to match with the expected molecular weight.

3. Conclusions

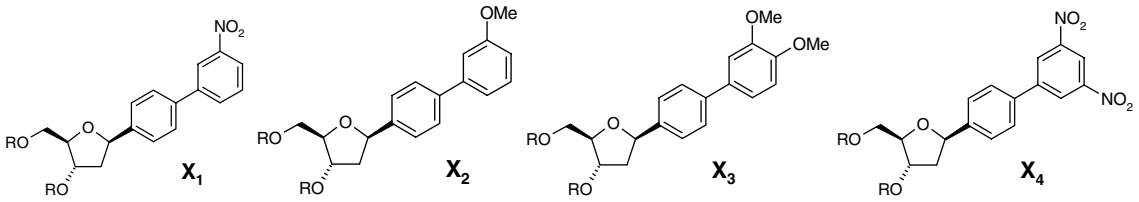
We have developed a short and highly convergent synthesis of a series of novel biphenyl *C*-nucleosides with electron withdrawing or electron donating functional groups in the distal phenyl ring based on the Suzuki coupling for biarylic bond formation. These *C*-nucleosides were easily converted into the corresponding phosphoramidite building blocks for DNA synthesis and incorporated into oligodeoxynucleotides by standard phosphoramidite chemistry. Experiments toward the determination of the pairing properties of these modified oligonucleotides as well as toward their charge transport properties are currently underway and will be reported in due time.

4. Experimental

4.1. General

All reactions were performed in dried glassware under argon. All chemicals were purchased from commercial suppliers (Fluka, Aldrich) and were used without further purification. Solvents for reactions were dried and purified by filtration over alumina (THF, Et_2O, CH_2Cl_2 and toluene), distilled over CaH_2 (pyridine, CH_3CN) or purchased as crown-cap bottles from Fluka (DMF, dioxane, pyridine and CH_3CN). Solvents for extractions and FC were distilled before use. Silica gel thin layer chromatography was performed using SIL G-25 UV254 plates from Macherey-Nagel. Visualization was done using UV-light (254 nm) or staining solutions

Table 4. Sequence and analytical data as well as isolated yields (OD_{260}) of oligonucleotides prepared



Sequence	Mass calcd $[M-H]^-$	Mass found $[M-H]^-$	OD_{260}
5′-GTGAC**X**$_4$GCAG-3′	3185.15	3185.60	43.4
5′-CTGC**X**$_3$GTCAC-3′	3066.15	3065.72	43.6
5′-GATGAC**X**$_1$GCTAG-3′	3757.52	3757.00	54.2
5′-CTAGC**X**$_1$GTCATC-3′	3668.45	3668.13	52.0
5′-GATGAC**X**$_2$GCTAG-3′	3742.54	3742.13	70.2
5′-CTAGC**X**$_2$GTCATC-3′	3653.48	3653.13	52.8
5′-GATGAC**X**$_3$GCTAG-3′	3772.57	3772.38	65.3
5′-CTAGC**X**$_3$GTCATC-3′	3683.51	3683.50	59.8
5′-GATGAC**X**$_4$GCTAG-3′	3802.51	3802.50	57.3
5′-CTAGC**X**$_4$GTCATC-3′	3713.45	3714.13	48.7
5′-GATGAC**X**$_1$**X**$_1$**X**$_1$GCTAG-3′	4512.14	4512.25	34.9
5′-CTAGC**X**$_1$**X**$_1$**X**$_1$GTCATC-3′	4423.08	4423.00	22.7
5′-GATGAC**X**$_2$**X**$_2$**X**$_2$GCTAG-3′	4467.23	4467.25	23.8
5′-CTAGC**X**$_2$**X**$_2$**X**$_2$GTCATC-3′	4378.17	4378.13	24.0
5′-GATGAC**X**$_3$**X**$_3$**X**$_3$GCTAG-3′	4557.31	4557.50	36.0
5′-CTAGC**X**$_3$**X**$_3$**X**$_3$GTCATC-3′	4468.25	4468.38	26.0
5′-GATGAC**X**$_4$**X**$_4$**X**$_4$GCTAG-3′	4647.14	4647.38	17.4
5′-CTAGC**X**$_4$**X**$_4$**X**$_4$GTCATC-3′	4558.07	4558.13	24.1

(either 2.1 g cerium(IV) sulfate, 4.2 g phosphomolybdic acid, 12 ml H_2SO_4, and 180 ml H_2O or 10 ml *p*-anisaldehyde, 2 ml acetic acid, 10 ml H_2SO_4, and 180 ml EtOH). Flash chromatography (FC) was performed with silica gel 60 A (particle size 40–63 μm). ^{1}H NMR spectra were recorded at 300 MHz on a Bruker Avance, or at 400 MHz on a Bruker DRX-400 spectrometer. Chemical shifts are reported in ppm relative to tetramethylsilane (TMS) as internal standard. Coupling constants *J* are in Hz. Multiplicities are abbreviated as follows: s = singlet, d = doublet, t = triplet, m = multiplet, and br = broad. ^{13}C NMR spectra were recorded at 75 MHz on a Bruker Avance, or at 101 MHz on a Bruker DRX-400 spectrometer. Chemical shifts are reported in ppm relative to TMS. Multiplicities are established by DEPT experiments and are abbreviated as follows: s = singlet, d = doublet, t = triplet, q = quadruplet, and m = multiplet. ^{1}H/^{1}H and ^{1}H/^{13}C correlation experiments (COSY, HMSC) were used for signal assignments. ^{31}P NMR spectra were recorded at 162 MHz on a Bruker DRX-400 spectrometer using 85% H_3PO_4 as an external standard. ^{1}H NMR-NOE experiments were recorded on a Bruker DRX-400 spectrometer. Electron impact mass spectra (EI-MS) were recorded on a AutoSpeq Q VG with an ionization energy of 70 eV. Electrospray ionization mass spectra (ESI-MS) were recorded either on a Fisons Instrument VG Platform (low resolution) or on an Applied Biosystems, Sciex QSTAR Pulsar (high resolution). IR-spectra were recorded on a Perkin-Elmer Spectrum One. The absorption maxima (υ_{max}) are indicated in cm^{-1}. The intensities are abbreviated as follows: s (strong), m (medium), w (weak), and br (broad).

4.1.1. 3,5-Bis-*O*-(*tert*-butyldimethylsilyl)-2-deoxy-D-ribono-1,4-lactone (2). A solution of 2′-deoxy-D-ribose (**1**, 5 g, 37.3 mmol) and Br_2 (4.8 ml, 93.4 mmol) in H_2O (125 ml) was stirred for 5 d in the dark. The excess of bromine was removed in vacuo and the solution was neutralized with Ag_2CO_3. The mixture was filtered through Celite and concentrated in vacuo. The residue was dissolved in dry DMF (100 ml) and cooled to 0 °C. Imidazole (12.7 g, 186.5 mmol) and *tert*-butyldimethylchlorosilane (13.6 g, 90.2 mmol) were added and the solution was allowed to warm up to room temperature and was stirred for 16 h. The solution was poured into water (300 ml) and extracted with *t*-BuOMe (4 ×150 ml). The combined organic phases were washed with satd. $NaHCO_3$ solution (100 ml), water (100 ml), and brine (100 ml), dried ($MgSO_4$), filtered, and concentrated in vacuo. Purification by FC (silica gel; CH_2Cl_2) yielded the desired compound **2** (11.9 g, 33.0 mmol, 88%) as colorless crystals. R_f 0.5 (CH_2Cl_2). ^{1}H NMR (300 MHz, $CDCl_3$): δ 4.54–4.48 (m, 1H, H-C(4′)); 4.36–4.32 (m, 1H, H-C(3′)); 3.72–3.86 (m, 2H, H-C(5′)); 2.82 (dd, 1H, J_1 = 6.6, J_2 = 17.7, H-C(2′)); 2.39 (dd, 1H, J_1 = 2.6, J_2 = 17.6, H-C(2′)); 0.89 (s, 18H, 2× $C(CH_3)_3$); 0.09 (s, 12H, 4× Si–CH_3). ^{13}C NMR (75 MHz, $CDCl_3$): δ 175.75 (s, C(1′)); 88.08 (d, C(4′)); 69.58 (d, C(3′)); 62.43 (t, C(5′)); 39.00 (t, C(2′)); 25.77, 25.62 (2q, 2× C(*C*H$_3$)$_3$); 18.21, 17.89 (2s, 2× *C*(CH$_3$)$_3$); −4.78, −4.86, −5.55, −5.67 (4q, 4× Si–CH_3). ESI$^+$-MS (CH_3CN): *m*/*z* 361 ($[M+H]^+$). IR (KBr): υ_{max} 2958s, 2931s, 2888m, 2858s, 1772s, 1472m, 1391m, 1378m, 1362m, 1261s, 1172s, 1127s, 1094s, 1081s, 1008s, 969s, 944s, 916w, 863s, 839s, 781s, 754m, 722w, 687w, 666m, 601w, 540w.

4.1.2. 4-(3′,5′-*O*-(*tert*-butyldimethylsilyl)-2′-deoxy-β-D-ribofuranosyl)-1-bromobenzene (3a). To a stirred solution of *p*-dibromobenzene (12.5 g, 53.2 mmol) in dry THF (125 ml) at −78 °C, *n*-BuLi (1.6 M in hexane, 32 ml, 51.2 mmol) was added fast. After 0.5 h at −78 °C, a solution of **2** (11.5 g, 31.89 mmol) in dry THF (125 ml) was slowly added. The solution was stirred for 1 h at −78 °C and then quenched with sat. NH_4Cl solution (200 ml). The mixture was extracted with CH_2Cl_2 (4 × 150 ml). The combined organic phases were washed with sat. NH_4Cl solution (100 ml), H_2O (100 ml), and brine (100 ml), dried ($MgSO_4$), and concentrated in vacuo. The yellow residue was dissolved in dry CH_2Cl_2 (125 ml) and the solution was cooled to −78 °C. Triethylsilane (15.2 ml, 95.6 mmol) followed by $BF_3{\cdot}OEt_2$ (12.1 ml, 95.8 mmol) was added dropwise. The solution was stirred at −78 °C for 6 h and then quenched with sat. $NaHCO_3$ solution (200 ml). The mixture was extracted with CH_2Cl_2 (4 × 150 ml). The combined organic phases were washed with sat. $NaHCO_3$ solution (100 ml), H_2O (100 ml), and brine (100 ml), dried ($MgSO_4$), and concentrated in vacuo. Purification by FC (silica gel; toluene) yielded the desired compound **3a** (3.03 g, 6.0 mmol, 19%, β-anomer only) as a slightly yellow oil. R_f 0.5 (Toluene). ^{1}H NMR (400 MHz, $CDCl_3$,): δ 7.44 (d, J = 8.6, 2H, H(arom)); 7.26 (d, 2H, J = 8.6, H(arom)); 5.10 (dd, 1H, J_1 = 5.4, J_2 = 10.3, H-C(1′)); 3.99–3.94 (m, 1H, H-C(3′)); 3.79–3.74 (m, 1H, H-C(4′)); 3.77 (dd, 1H, J_1 = 3.7, J_2 = 10.8, H-C(5′)); 3.33 (dd, 1H, J_1 = 5.6, J_2 = 10.8, H-C(5′)); 2.11 (ddd, 1H, J_1 = 1.5, J_2 = 5.4, J_3 = 12.6, H_α-C(2′)); 1.89–1.81 (m, 1H, H_β-C(2′)); 0.92, 0.91 (2s, 18H, 2× $C(CH_3)_3$); 0.10, 0.09 (2s, 12H, 4× Si–CH_3). ^{13}C NMR (75 MHz, $CDCl_3$): δ 141.53 (s, C(arom)); 131.28, 127.74 (2d, C(arom)); 121.01 (s, C(arom)); 88.14 (d, C(4′)); 79.43 (d, C(1′)); 74.31 (d, C(3′)); 63.76 (t, C(5′)); 44.40 (t, C(2′)); 25.90, 25.81 (2q, 2× C(CH_3)$_3$); 18.33, 18.03 (2s, 2× $C(CH_3)_3$); −4.66, −4.69, −5.40, −5.48 (4q, 4× Si–CH_3). Difference-NOE: 5.10 (H-C(1′)) → 3.79–3.74 (H-C(4′), 3%), 2.11 (H-C(2′), 5%); 3.99–3.94 (H-C(3′)) → 3.74 (H-C(4′), 4%), 1.89–1.81 (H-C(2′), 5%); 3.74 (H-C(4′)) → 5.10 (H-C(1′), 3%), 3.99–3.94 (H-C(3′), 3%), 3.77 (H-C(5′), 4%). HR-ESI$^+$-MS: m/z 523.1687 ($[M+Na]^+$; $C_{23}H_{41}BrO_3Si_2Na$ calcd 523.1675). IR (KBr): υ_{max} 2959m, 2931m, 2898w, 2859m, 1490w, 1473w, 1390w, 1362w, 1257m, 1172w, 1092m, 1032w, 1012m, 971w, 939w, 837s, 777m, 666w.

4.1.3. 4-(2′-Deoxy-β-D-ribofuranosyl)-1-bromobenzene (3b). To a solution of **3a** (3.0 g, 5.98 mmol) in dry THF (120 ml) at −10 °C, acetic acid (350 µl, 6.1 mmol) and TBAF (5.7 g, 18.07 mmol) were added. After 5 min, the solution was allowed to warm up to room temperature. After 16 h, the solution was concentrated in vacuo. Purification by FC (silica gel; CH_2Cl_2/MeOH 19:1) yielded the desired compound **3b** (1.23 g, 4.5 mmol, 75%) as colorless crystals. R_f 0.3 (CH_2Cl_2/MeOH 19:1). ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.50 (d, J = 8.5, 2H, H(arom)); 7.31 (d, 2H, J = 8.1, H(arom)); 5.07 (d, 1H, J = 3.6, HO-C(3′)); 4.97 (dd, 1H, J_1 = 5.5, J_2 = 10.5, H-C(1′)); 4.76 (t, 1H, J = 5.5, HO-C(5′)); 4.20–4.13 (m, 1H, H-C(3′)); 3.80–3.74 (m, 1H, H-C(4′)); 3.52–3.35 (m, 2H, 2× H-C(5′)); 2.06 (ddd, 1H, J_1 = 1.5, J_2 = 5.3, J_3 = 12.6, H-C(2′)); 1.77–1.65 (m, 1H, H-C(2′)). ^{13}C NMR (101 MHz, DMSO-d_6): δ 142.45 (s, C(arom)); 131.17, 128.37 (2d, C(arom)); 120.24 (s, C(arom)); 88.07 (d, C(4′)); 78.70 (d, C(1′)); 72.56 (d, C(3′)); 62.56 (t, C(5′)); 43.79 (t, C(2′)). HR-EI-MS: m/z 272.0049 (M^+; $C_{11}H_{13}BrO_3$ calcd 272.0048). IR (KBr): υ_{max} 3393br, 2896m, 1593w, 1491m, 1441w, 1412m, 1336m, 1263w, 1213w, 1181w, 1061s, 1044s, 1011m, 998s, 972m, 946m, 920w, 893w, 875w, 821s, 748w, 694w, 595w, 536w, 503w, 473w.

4.1.4. 4-(3′,5′-*O*-Acetyl-2′-deoxy-β-D-ribofuranosyl)-1-bromo-benzene (3c). To a solution of **3b** (100 mg, 0.37 mmol) and DMAP (9 mg, 0.07 mmol) in dry pyridine (2.2 ml) at 0 °C, Ac_2O (90 µl, 0.95 mmol) was added dropwise. The mixture was stirred at room temperature over 16 h and then diluted with CH_2Cl_2 (50 ml). The mixture was washed with water (25 ml) and brine (25 ml), and the combined aqueous phases were extracted with CH_2Cl_2 (3 × 25 ml). The combined organic phases were dried ($MgSO_4$), filtered, and concentrated in vacuo. The residue was co-evaporated with toluene (2 × 5 ml). Purification by FC (silica gel, hexane/EtOAc 7:3) yielded the desired compound **3c** (130 mg, 0.36 mmol, 99%) as a colorless oil. R_f 0.4 (hexane/EtOAc 7:3). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.48 (d, 2H, J = 8.5, H-C(2), H-C(6)); 7.22 (d, 2H, J = 8.1, H-C(3), H-C(5)); 5.22 (d, 1H, J = 6.2, H-C(3′)); 5.07 (dd, 1H, J_1 = 5.1; J_2 = 10.7, H-C(1′)); 4.38 (dd, 1H, J_1 = 5.7, J_2 = 13.1, H-C(5′)); 4.29–4.21 (m, 2H, H-C(4′), H-C(5′)); 2.34 (ddd, 1H, J_1 = 0.8; J_2 = 5.2; J_3 = 13.8, H-C(2′)); 2.12, 2.08 (2s, 6H, 2× CH_3); 2.10–1.94 (m, 1H, H-C(2′)). ^{13}C NMR (101 MHz, $CDCl_3$): δ 170.66, 170.51 (2s, 2× C=O); 139.76 (s, C(4)); 131.63 (d, C(3), C(5)); 127.47 (d, C(2), C(6)); 121.67 (s, C(1)); 82.77 (d, C(4′)); 79.96 (d, C(1′)); 76.55 (d, C(3′)); 64.32 (t, H-C(5′)); 41.27 (t, H-C(2′)); 21.08, 20.84 (2q; 2× CH_3). HR-EI-MS: m/z 356.0260 (M^+; $C_{15}H_{17}BrO_5$ calcd 356.0259). IR (neat): υ_{max} 1736s, 1488w, 1434w, 1364w, 1223s, 1177w, 1094w, 1052m, 1009m, 946w, 864w, 817m, 687w, 631w, 605w.

4.1.5. 4-[3′,5′-*O*-(2-Tetrahydro-2*H*-pyranyl)-2′-deoxy-β-D-ribofuranosyl]-1-bromobenzene (3d). To a solution of **3b** (300 mg, 1.1 mmol) and TsOH (42 mg, 0.22 mmol) in dry THF (5 ml), 3,4-dihydro-2*H*-pyran (300 µl, 3.3 mmol) was added dropwise at 0 °C. The mixture was stirred at room temperature for 16 h and then diluted with *t*-BuOMe (100 ml). The mixture was washed with sat. $NaHCO_3$ solution (50 ml), water (50 ml), and brine (50 ml), and the combined aqueous phases were extracted with *t*-BuOMe (3 × 25 ml). The combined organic phases were dried ($MgSO_4$), filtered, and concentrated in vacuo. Purification by FC (silica gel, hexane/EtOAc 9:1) yielded the desired compound **3d** (381 mg, 0.86 mmol, 78%) as a colorless oil. R_f 0.3 (hexane/EtOAc 9:1). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.44 (d, 2H, J = 8.5, H-C(arom)); 7.31–7.23 (m, 2H, H-C(arom)); 5.14–5.01 (m, 1H, H-C(1″)); 4.74–4.64 (m, 2H, H-THP); 4.48–4.16 (m, 2H, H-C(3″), H-C(4″)); 4.00–3.79 (m, 3H, H-C(5″), H-THP); 3.64–3.47 (m, 3H, H-C(5″), H-THP); 2.51–2.21 (m, 1H, H-C(2″)); 2.04–1.46 (m, 13H, H-C(2″), H-THP). ^{13}C NMR

(75 MHz, $CDCl_3$): δ 141.36, 141.28, 141.24 (3s, C(arom)); 131.34, 127.80, 127.73 (3d, C(arom)); 121.13 (s, C(arom)); 99.21, 99.11, 98.68, 98.64, 98.61, 98.45, 97.28, 97.12 (8d, C(THP)); 84.83, 84.58, 84.32, 84.16 (*4d*, C(4″)); 80.00, 79.89, 79.80, 79.65, 79.37, 79.30, 78.29, 78.01 (8d, C(1″), C(3″)); 68.46, 68.23, 68.03, 63.16, 62.36, 62.23, 62.17, 62.05, 61.83, 61.64 (10t, C(5″), C(THP)); 42.58, 42.36, 41.47, 41.14 (4t, C(2″)); 31.08, 31.07, 30.87, 30.82, 30.73, 30.55, 30.45, 30.41, 25.43, 19.96, 19.43, 19.40, 19.35, 19.32, 19.12, 19.04 (16t, C(THP)). HR-ESI$^+$-MS: *m/z* 463.1093 ([M+Na]$^+$; $C_{21}H_{29}BrO_5Na$ calcd 463.1096). IR (neat): υ_{max} 2939m, 2868w, 1486w, 1439w, 1350w, 1259w, 1201w, 1122s, 1070s, 1009s, 968s, 904m, 870m, 814s.

4.2. General procedure for Suzuki coupling

Method A. A mixture of **3c** (1 equiv), phenylboronic acid (1.5 equiv), KF (3 equiv), $Pd(OAc)_2$ (1 mol%), and 2-(di-*tert*-butylphosphino)biphenyl (2 mol%) in dry THF (1 ml/mmol) was stirred at room temperature over 16 h in a sealed flask. The mixture was poured into water and extracted with CH_2Cl_2. The combined organic phases were washed with brine, dried ($MgSO_4$), filtered, and concentrated in vacuo. Purification by FC (silica gel, hexane/EtOAc) yielded the desired compounds.

Method B. Same procedure, but **3d** as starting material.

Method C. A solution of **3b** (1 equiv), pinacolboronate (1.5 equiv), and K_3PO_4 (3 equiv) in dry DMF (5 ml/mmol) was degassed by bubbling Ar through it for 15 min. $Pd(PPh_3)_4$ (3 mol%) was added and the solution was heated to 85 °C. After 16 h, the mixture was allowed to cool to room temperature and was diluted with CH_2Cl_2. The mixture was washed with 2 M NaOH solution. The combined aqueous phases were extracted with CH_2Cl_2. The combined organic phases were washed with brine, dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude product and DMAP (0.2 equiv) were dissolved in dry pyridine (6 ml/equiv) and the solution was cooled to 0 °C. Ac_2O (2.6 equiv) was added dropwise. The mixture was stirred at room temperature for 16 h and then diluted with CH_2Cl_2. The mixture was washed with water and brine and the combined aqueous phases were extracted with CH_2Cl_2 (3×). The combined organic phases were dried ($MgSO_4$), filtered and concentrated in vacuo. Purification by FC (silica gel, hexane/EtOAc) yielded the desired compounds.

Method D. Same procedure as for Suzuki coupling, but protection of the crude product with THP using the following conditions: The crude product and TosOH (0.2 equiv) were dissolved in dry THF (6 ml/mmol) and 3,4-dihydro-2*H*-pyran (3 equiv) was added dropwise at 0 °C. The mixture was stirred at room temperature for 16 h and then diluted with *t*-BuOMe. The mixture was washed with sat. $NaHCO_3$ solution, water, and brine, and the combined aqueous phases were extracted with *t*-BuOMe. The combined organic phases were dried ($MgSO_4$), filtered, and concentrated in vacuo. Purification by FC (silica gel, hexane/EtOAc) yielded the desired compounds.

4.2.1. 4′-(3″,5″-Di-*O*-acetyl-2″-deoxy-β-D-ribofuranosyl)-3,5-dinitrobiphenyl (4a). *Method C*. Slightly yellow foam (134 mg, 0.3 mmol, 41%). R_f 0.3 (hexane/EtOAc 7:3). ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.02 (t, 1H, J = 2.1, H-C(arom)); 8.76 (d, 2H, J = 2.1, H-C(arom)); 7.69 (d, 2H, J = 8.3, H-C(arom)); 7.55 (d, 2H, J = 8.1, H-C(arom)); 5.27 (d, 1H, J = 6.2, H-C(3″)); 5.21 (dd, 1H, J_1 = 5.1, J_2 = 10.9, H-C(1″)); 4.42 (dd, 1H, J_1 = 5.5, J_2 = 13.0, H-C(5″)); 4.33–4.26 (m, 2H, H-C(4″), H-C(5″)); 2.43 (ddd, 1H, J_1 = 1.1, J_2 = 5.2, J_3 = 13.7, H-C(2″)); 2.15, 2.11 (2s, 6H, 2× CH_3); 2.15–2.02 (m, 1H, H-C(2″)). ^{13}C NMR (101 MHz, $CDCl_3$): δ 170.67, 170.55 (2s, 2× C═O); 149.02, 144.42, 142.90, 135.91 (4s, C(arom)); 127.41, 127.00, 126.82, 117.17 (4d, C(arom)); 82.90 (d, C(4″)); 79.99 (d, C(1″)); 76.54 (d, C(3″)); 64.32 (t, C(5″)); 41.37 (t, C(2″)); 21.10, 20.89 (2q, CH_3). HR-EI-MS: *m/z* 444.1170 (M$^+$; $C_{21}H_{20}N_2O_9$ calcd 444.1169). IR (neat): υ_{max} 1734s, 1538s, 1519m, 1435w, 1344s, 1225s, 1179w, 1096w, 1051m, 947w, 907w, 829m, 777w, 728s, 668w, 606w.

4.2.2. 4′-(3″,5″-Di-*O*-acetyl-2″-deoxy-β-D-ribofuranosyl)-4-nitrobiphenyl (4b). *Method C*. Yellow crystals (239 mg, 0.6 mmol, 82%) that can be recrystallized from CH_2Cl_2/hexane. R_f 0.3 (hexane/EtOAc 7:3). ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.30 (d, 2H, J = 8.9, H-C(arom)); 7.73 (d, 2H, J = 8.9, 8.9, H-C(arom)); 7.62 (d, 2H, J = 8.5, H-C(arom)); 7.48 (d, 2H, J = 8.3, H-C(arom)); 5.26 (d, 1H, J = 6.2, H-C(3″)); 5.18 (dd, 1H, J_1 = 5.1, J_2 = 10.8, H-C(1″)); 4.42 (dd, 1H, J_1 = 5.5, J_2 = 12.8, H-C(5″)); 4.33–4.25 (m, 2H, H-C(4″), H-C(5″)); 2.41 (ddd, 1H, J_1 = 0.9, J_2 = 5.1, J_3 = 13.8, H-C(2″)); 2.14, 2.10 (2s, 6H, 2× CH_3); 2.13–2.03 (m, 1H, H-C(2″)). ^{13}C NMR (101 MHz, $CDCl_3$): δ 170.70, 170.56 (2s, 2× (C═O)); 147.17, 147.15, 141.67, 138.36 (4s, C(arom)); 127.73, 127.56, 126.59, 124.15 (4d, C(arom)); 82.79 (d, C(4″)); 80.18 (d, C(1″)); 77.22 (d, C(3″)); 64.36 (t, C(5″)); 41.28 (t, C(2″)); 21.10, 20.88 (2q, 2× CH_3). HR-EI-MS: *m/z* 399.1321 (M$^+$; $C_{21}H_{21}NO_7$; calcd 399.1318). IR (KBr): υ_{max} 2913w, 2878w, 1749s, 1734s, 1602m, 1594m, 1514s, 1489w, 1430w, 1380m, 1341s, 1297w, 1266m, 1243s, 1217s, 1177m, 1111w, 1091m, 1073m, 1050m, 1021w, 952w, 927m, 872w, 859w, 825m, 760w, 752w, 736w, 697w, 675w, 661w, 630w, 585w, 559w, 506w.

4.2.3. 4′-(3″,5″-Di-*O*-acetyl-2″-deoxy-β-D-ribofuranosyl)-3-methoxybiphenyl (4c). *Method A*. Colorless oil (130 mg, 0.34 mmol, 94%). R_f 0.4 (hexane/EtOAc 8:3). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.58 (d, 2H, J = 8.3, H-C(arom)); 7.45–7.32 (m, 3H, H-C(arom)); 7.20–7.09 (m, 2H, H-C(arom)); 6.90 (ddd, 1H, J_1 = 0.8, J_2 = 2.5, J_3 = 8.2, H-C(arom)); 5.25 (d, 1H, J = 6.2, H-C(3″)); 5.16 (dd, 1H, J_1 = 5.1, J_2 = 10.9, H-C(1″)); 4.41 (dd, 1H, J_1 = 5.8, J_2 = 13.4, H-C(5″)); 4.32–4.23 (m, 2H, H-C(4″), H-C(5″)); 3.86 (s, 3H, –OCH_3); 2.38 (ddd, 1H, J_1 = 0.9, J_2 = 5.1, J_3 = 13.8, H-C(2″)); 2.14, 2.10 (2s, 6H, 2× CH_3); 2.18–2.03 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 170.75, 170.58 (2s, (C═O)); 159.97, 142.33, 140.79, 139.80 (4s, C(arom)); 129.78, 127.33, 126.29, 119.62, 112.88, 112.74 (6d, C(arom)); 82.70 (d, C(4″)); 80.43 (d, C(1″)); 76.71 (d, C(3″)); 64.45 (t, C(5″)); 55.31 (q, –OCH_3); 41.22 (t, C(2″));

21.12, 20.89 (2q, 2× CH_3). HR-EI-MS: *m/z* 384.1572 (M^+; $C_{22}H_{24}O_6$ calcd 384.1573). IR (neat): υ_{max} 1736s, 1600w, 1565w, 1481w, 1435w, 1364w, 1296w, 1220s, 1175m, 1095w, 1051m, 1029m, 1014m, 946w, 866w, 829m, 780m, 732w, 696w, 606w.

4.2.4. 4′-(3″,5″-Di-*O*-acetyl-2″-deoxy-β-D-ribofuranosyl)-4-methoxybiphenyl (4d). *Method A*. Colorless crystals (183 mg, 0.48 mmol, 95%) that can be recrystallized from CH_2Cl_2/hexane. R_f 0.3 (hexane/EtOAc 8:2). ^1H NMR (300 MHz, $CDCl_3$): δ 7.57–7.49 (m, 4H, H-C(arom)); 7.40 (d, 2H, *J* = 8.1, H-C(arom)); 6.97 (d, 2H, *J* = 8.9, H-C(arom)); 5.25 (d, 1H, *J* = 6.2, H-C(3″)); 5.15 (dd, 1H, J_1 = 5.1, J_2 = 10.7, H-C(1″)); 4.45–4.36 (m, 1H, H-C(5″)); 4.32–4.22 (m, 2H, H-C(4″), H-C(5″)); 3.85 (s, 3H, –OCH_3); 2.37 (ddd, 1H, J_1 = 0.9, J_2 = 5.1, J_3 = 13.8, H-C(2″)); 2.13, 2.10 (2s, 6H, 2× CH_3); 2.17–2.05 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 170.77, 170.60 (2s, 2×(C=O)); 159.23, 140.56, 138.92, 133.33 (4s, C(arom)); 128.11, 126.84, 126.32, 114.25 (4d, C(arom)); 82.66 (d, C(4″)); 80.49 (d, C(1″)); 76.74 (d, C(3″)); 64.47 (t, C(5″)); 55.36 (q, –OCH_3); 41.19 (t, C(2″)); 21.13, 20.89 (2q, 2× CH_3). HR-EI-MS: *m/z* 384.1574 (M^+); $C_{22}H_{24}O_6$ calcd 384.1573. IR (KBr): υ_{max} 2957w, 2877w, 1745s, 1607w, 1500m, 1448w, 1381m, 1321w, 1312w, 1287m, 1266s, 1247s, 1201m, 1177m, 115w, 1097w, 1076m, 1059s, 1036m, 1022m, 1001w, 966w, 942w, 867w, 816s, 710w, 666w, 651w, 605w, 524w.

4.2.5. 4′-(3″,5″-Di-*O*-acetyl-2″-deoxy-β-D-ribofuranosyl)-3,4-dimethoxybiphenyl (4e). *Method A*. Colorless solid (309 mg, 0.74 mmol, 93%). R_f 0.2 (hexane/EtOAc 7:3). ^1H NMR (300 MHz, $CDCl_3$): δ 7.55 (d, 2H, *J* = 8.3, H-C(arom)); 7.41 (d, 2H, *J* = 8.3, H-C(arom)); 7.17–7.08 (m, 2H, H-C(arom)); 6.94 (d, 1H, *J* = 8.3, H-C(arom)); 5.26 (d, 1H, *J* = 6.2, H-C(3″)); 5.16 (dd, 1H, J_1 = 5.1, J_2 = 10.9, H-C(1″)); 4.41 (dd, 1H, J_1 = 5.8, J_2 = 13.4, H-C(5″)); 4.32–4.24 (m, 2H, H-C(4″), H-C(5″)); 3.95, 3.92 (2s, 6H, 2× –OCH_3); 2.37 (dd, 1H, J_1 = 5.1, J_2 = 13.8, H-C(2″)); 2.17–2.04 (m, 1H, H-C(2″)); 2.14, 2.10 (2s, 6H, 2× CH_3). ^{13}C NMR (75 MHz, $CDCl_3$): δ 170.75, 170.58 (2s, 2×(C=O)); 149.21, 148.73, 140.76, 139.18, 133.82 (5s, C(arom)); 126.97, 126.30, 119.38, 111.54, 110.43 (5d, C(arom)); 82.67 (d, C(4″)); 80.45 (d, C(1″)); 76.72 (d, C(3″)); 64.45 (t, C(5″)); 56.01, 55.97 (2q, 2× –OCH_3); 41.22 (t, C(2″)); 21.12, 20.89 (2q, 2× CH_3). HR-EI-MS: *m/z* 414.1677 (M^+; $C_{23}H_{26}O_7$ calcd 414.1679). IR (KBr): υ_{max} 2954w, 2842w, 1748s, 1734s, 1603w, 1589w, 1527w, 1507m, 1465w, 1444w, 1384w, 1371w, 1327w, 1248s, 1218s, 1186w, 1173m, 1146m, 1095w, 1053m, 1024m, 1004w, 987w, 948w, 882w, 851w, 831w, 808m, 764w, 608w, 586w, 547w.

4.2.6. 4′-(3″,5″-Di-*O*-acetyl-2″-deoxy-β-D-ribofuranosyl)-3-nitrobiphenyl (4f). *Method A*. Colorless oil (140 mg, 0.35 mmol, 97%). R_f 0.3 (hexane/EtOAc 7:3). ^1H NMR (300 MHz, $CDCl_3$): δ 8.45 (t, 1H, *J* = 2.1, H-C(arom)); 8.24–8.17 (m, 1H, H-C(arom)); 7.93–7.89 (m, 1H, H-C(arom)); 7.65–7.58 (m, 2H, H-C(arom)); 7.48 (d, 1H, *J* = 8.1, H-C(arom)); 5.26 (d, 1H, *J* = 6.4, H-C(3″)); 5.19 (dd, 1H, J_1 = 5.1, J_2 = 10.9, H-C(1″)); 4.42 (dd, 1H, J_1 = 5.7, J_2 = 13.0, H-C(5″)); 4.33–4.25 (m, 2H, H-C(4″), H-C(5″)); 2.40 (ddd, 1H, J_1 = 1.0, J_2 = 5.2, J_3 = 13.75, H-C(2″)); 2.15–2.05 (m, 1H, H-C(2″)); 2.14, 2.11 (2s, 6H, 2× CH_3). ^{13}C NMR (75 MHz, $CDCl_3$): δ 170.70, 170.56 (2s, 2×(C=O)); 148.79, 142.45, 141.24, 138.28 (4s, C(arom)); 132.94, 129.76, 127.33, 126.63, 122.11, 121.88 (6d, C(arom)); 82.80 (d, C(4″)); 80.21 (d, C(1″)); 76.63 (d, C(3″)); 64.38 (t, C(5″)); 41.30 (t, C(2″)); 21.10, 20.88 (2q, 2× CH_3). HR-EI-MS: *m/z* 399.1321 (M^+; $C_{21}H_{21}NO_7$ calcd 399.1318). IR (neat): υ_{max} 1736s, 1530m, 1517m, 1434w, 1348s, 1225s, 1178w, 1098w, 1052m, 946w, 908w, 876w, 832w, 805w, 767w, 727s, 682w, 648w, 605w.

4.2.7. 4′-[3″,5″-Di-*O*-(2-tetrahydro-2*H*-pyranyl)-2″-deoxy-β-D-ribofuranosyl]-4-nitrobiphenyl (4g). *Method D*. Yellow oil (274 mg, 0.57 mmol, 65%). R_f 0.3 (hexane/EtOAc 8:2). ^1H NMR (300 MHz, $CDCl_3$): δ 8.28 (d, 2H, *J* = 8.9, H-C(arom)); 7.23 (d, 2H, *J* = 8.9, H-C(arom)); 7.62–7.49 (m, 4H, H-C(arom)); 5.27–5.13 (m, 1H, H-C(1″)); 4.78–4.68 (m, 2H, H-THP); 4.52–4.40 (m, 1H, H-C(3″)); 4.37–4.21 (m, 1H, H-C(4″)); 4.04–3.82 (m, 3H, H-C(5″), H-THP); 3.68–3.48 (m, 3H, H-C(5″), H-THP); 2.52–2.27 (m, 1H, H-C(2″)); 2.11–1.48 (m, 13H, H-C(2″), H-THP). ^{13}C NMR (75 MHz, $CDCl_3$): δ 147.42, 147.03, 143.31, 143.24, 143.19, 137.86 (6s, C(arom)); 127.68, 127.33, 126.89, 126.86, 126.82, 126.80, 124.09 (7d, C(arom)); 99.25, 99.14, 98.73, 98.66, 98.58, 98.53, 97.31, 97.13 (8d, C(THP)); 84.89, 84.62, 84.38, 84.22 (4d, C(4″)); 80.21, 80.11, 80.02, 79.86, 79.45, 79.40, 78.34, 78.06 (8d, C(1″), C(3″)); 68.50, 68.28, 68.09, 63.25, 62.38, 62.24, 62.20, 62.07, 61.88, 61.70 (10t, C(5″), C(THP)); 42.59, 42.36, 41.47, 41.13 (4t, C(2″)); 31.13, 30.89, 30.84, 30.59, 30.48, 30.44, 25.44, 20.01, 19.43, 19.38, 19.32, 19.15, 19.08 (13t, C(THP)). HR-ESI$^+$-MS: *m/z* 506.2156 ($[M+Na]^+$; $C_{27}H_{33}NO_7Na$ calcd 506.2154). IR (neat): υ_{max} 2939w, 2868w, 1736w, 1595w, 1515m, 1486w, 1441w, 1340s, 1240w, 1200w, 1179w, 1119m, 1073s, 1032s, 1019s, 970m, 905m, 868m, 854m, 823m, 757m, 729w, 696w, 643w, 625w, 605w.

4.2.8. 4′-[3″,5″-Di-*O*-(2-tetrahydro-2*H*-pyranyl)-2″-deoxy-β-D-ribofuranosyl]-3-nitrobiphenyl (4h). *Method B*. Slightly yellow oil (324 mg, 0.67 mmol, 80%). R_f 0.2 (hexane/EtOAc 8:2). ^1H NMR (300 MHz, $CDCl_3$): δ 8.44 (t, 1H, *J* = 2.1, H-C(arom)); 8.22–8.15 (m, 1H, H-C(arom)); 7.90 (d, 1H, *J* = 7.9, H-C(arom)); 7.64–7.48 (m, 5H, H-C(arom)); 5.28–5.12 (m, 1H, H-C(1″)); 4.80–4.68 (m, 2H, H-THP); 4.53–4.40 (m, 1H, H-C(3″)); 4.37–4.20 (m, 1H, H-C(4″)); 4.04–3.82 (m, 3H, H-C(5″), H-THP); 3.69–3.48 (m, 3H, H-C(5″), H-THP); 2.52–2.27 (m, 1H, H-C(2″)); 2.12–1.48 (m, 13H, H-C(2″), H-THP). ^{13}C NMR (75 MHz, $CDCl_3$): δ 148.77, 142.86, 142.79, 142.73, 142.69, 137.80 (6s, C(arom)); 132.95, 129.68, 127.09, 126.92, 126.90, 126.85, 126.83, 121.94, 121.85 (9d, C(arom)); 99.27, 99.17, 98.72, 98.64, 98.56, 98.51, 97.30, 97.12 (8d, C(THP)); 84.89, 84.61, 84.37, 84.21 (4d, C(4″)); 80.25, 80.14, 80.05, 79.89, 79.47, 79.40, 78.36, 78.07 (8d, C(1″), C(3″)); 68.53, 68.30, 68.10, 63.23, 62.38, 62.24, 62.20, 62.08, 61.87, 61.68 (10t, C(5″), C(THP)); 42.61, 42.38, 41.50, 41.15 (4t, C(2″)); 31.13, 30.90, 30.84,

30.60, 30.48, 30.45, 25.49, 25.45, 20.00, 19.44, 19.39, 19.32, 19.16, 19.07 (14t, C(THP)). HR-EI-MS: *m/z* 483.2253 (M^+; $C_{27}H_{33}NO_7$ calcd 483.2257). IR (neat): υ_{max} 2939m, 2868w, 1529m, 1439w, 1348s, 1261w, 1201w, 1122s, 1070s, 1016s, 970s, 903m, 874m, 808m, 766w, 727m, 681m.

4.2.9. General procedure for the preparation of the biphenylamines. To solutions of the nitro-biphenyl-nucleosides **4g**–**h** (1 equiv) in EtOAc (5 ml/mmol) and MeOH (1 ml/mmol) was added Pd/C (10% w/w) and the suspensions were stirred under 1 atm H_2 at room temperature for 4 h. The suspensions were filtered over celite, washed with EtOAc, and concentrated in vacuo. The crude products, Fmoc-Cl (2.2 equiv) and ^{i}Pr$_2$NEt (2.2 equiv), were dissolved in CH_2Cl_2 (6 ml/mmol). The solutions were stirred at room temperature for 16 h and then diluted with CH_2Cl_2. The mixtures were washed with sat. $NaHCO_3$ solution, water, and brine, and the combined aqueous phases were extracted with CH_2Cl_2. The combined organic phases were dried ($MgSO_4$), filtered, and concentrated in vacuo. Purification by FC (silica gel) yielded the desired Fmoc-protected amino-compounds **5a**–**b**.

4.2.10. 4′-(3″,5″-Di-*O*-(2-tetrahydro-2*H*-pyranyl)-2″-deoxy-β-D-ribofuranosyl)-4-Fmoc-aminobiphenyl (5a). Colorless foam (489 mg, 0.72 mmol, 67%). R_f 0.2 (hexane/EtOAc 8:2). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.78 (d, 2H, J = 7.4, H-C(arom)); 7.63 (d, 2H, J = 7.4, H-C(arom)); 7.55–7.29 (m, 12H, H-C(arom)); 6.83 (s, 1H, –NH–); 5.23–5.10 (m, 1H, H-C(1″)); 4.77–4.67 (m, 2H, H-THP); 4.56 (d, 2H, J = 6.6, H-Fmoc); 4.52–4.38 (m, 1H, H-C(3″)); 4.34–4.18 (m, 2H, H-C(4″), H-Fmoc); 4.02–3.80 (m, 3H, H-C(5″), H-THP); 3.66–3.48 (m, 3H, H-C(5″), H-THP); 2.49–2.24 (*m*, 1H, H-C(2″)); 2.12–1.47 (m, 13H, H-C(2″), H-THP). ^{13}C NMR (75 MHz, $CDCl_3$): δ 153.39 (s, C=O); 143.75, 141.39, 140.99, 140.91, 140.88, 139.71, 136.95, 136.31 (8s, C(arom)); 127.80, 127.62, 127.14, 126.69, 126.58, 126.54, 124.94, 120.06, 119.14 (9d, C(arom)); 99.26, 99.15, 98.68, 98.59, 98.48, 98.44, 97.22, 97.05 (8d, C(THP)); 84.75, 84.47, 84.27, 84.09 (4d, C(4″)); 80.43, 80.33, 80.22, 80.07, 79.48, 79.44, 78.35, 78.09 (8d, C(1″), C(3″)); 68.55, 68.34, 68.31, 68.14, 63.88, 63.18, 62.32, 62.16, 62.03, 61.83, 61.62 (11t, C(5″), C(THP), C(Fmoc)); 47.18 (d, C(Fmoc)); 42.46, 42.22, 41.35, 40.98 (4t, C(2″)); 31.11, 30.89, 30.85, 30.57, 30.47, 30.43, 25.45, 19.99, 19.42, 19.36, 19.30, 19.12, 19.03 (13t, C(THP)). HR-ESI$^+$-MS: *m/z* 698.3109 ([M+Na]$^+$; $C_{42}H_{45}NO_7Na$ calcd 698.3093). IR (KBr): υ_{max} 2943s, 2868m, 1735s, 1596m, 1571w, 1535s, 1479w, 1452m, 1422w, 1402w, 1353w, 1319m, 1216s, 1125m, 1075s, 1034s, 971m, 905w, 869w, 818m, 759m, 741m, 622w, 526w.

4.2.11. 4′-(3″,5″-Di-*O*-(2-tetrahydro-2*H*-pyranyl)-2″-deoxy-β-D-ribofuranosyl)-3-Fmoc-aminobiphenyl (5b). Colorless foam (383 mg, 0.57 mmol, 64%). R_f 0.2 (hexane/EtOAc 8:2). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.77 (d, 2H, J = 7.5, H-C(arom)); 7.65–7.50 (m, 5 H, H-C(arom)); 7.47–7.26 (m, 9H, H-C(arom)); 6.83 (s, 1H, –HN–); 5.23–5.09 (m, 1H, H-C(1″)); 4.77–4.67 (m, 2H, H-THP); 4.55 (d, 2H, J = 6.6, H-Fmoc); 4.51–4.38 (m, 1H, H-C(3″)); 4.35–4.18 (m, 2H, H-C(4″), H-Fmoc); 4.02–3.81 (m, 3H, H-C(5″), H-THP); 3.66–3.47 (m, 3H, H-C(5″), H-THP); 2.49–2.23 (m, 1H, H-C(2″)); 2.11–1.47 (m, 13H, H-C(2″), H-THP). ^{13}C NMR (75 MHz, $CDCl_3$): δ 153.40 (s, C=O); 143.72, 141.98, 141.35, 139.86, 138.11 (5s, C(arom)); 129.40, 127.76, 127.11, 127.05, 126.53, 126.51, 126.47, 126.45, 124.92, 122.37, 120.12, 117.57 (12d, C(arom)); 99.24, 99.14, 98.66, 98.57, 98.46, 98.40, 97.21, 97.04 (8d, C(THP)); 84.75, 84.47, 84.26, 84.08 (4d, C(4″)); 80.39, 80.28, 80.18, 80.02, 79.45, 79.40, 78.34, 78.06 (8d, C(1″), C(3″)); 68.52, 68.28, 68.10, 66.02, 63.13, 62.31, 62.16, 62.14, 62.02, 61.81, 61.60 (11t, C(5″), C(THP), C(Fmoc)); 47.14 (d, C(Fmoc)); 42.47, 42.22, 41.35, 40.99 (4t, C(2″)); 31.09, 30.86, 30.81, 30.55, 30.44, 30.40, 25.42, 19.95, 19.40, 19.34, 19.28, 19.10, 19.00 (13t, C(THP)). HR-ESI$^+$-MS: *m/z* 698.3069 ([M+Na]$^+$; $C_{42}H_{45}NO_7Na$ calcd 698.3093). IR (KBr): υ_{max} 2942s, 2869m, 1735s, 1610m, 1596m, 1550m, 1516w, 1487w, 1452m, 1403w, 1353w, 1321w, 1210s, 1125m, 1075s, 1035s, 971m, 905w, 870w, 832w, 789w, 760m, 741s, 697w, 622w, 543w.

4.2.12. General procedure for *O*-deprotection. *Method A*. Suspensions of the acetylated nucleosides **4** (1 equiv) and K_2CO_3 (1 equiv) in dry MeOH (5 ml/mmol) were stirred at room temperature over 36 h. The reaction mixtures were neutralized with 10% HCl solution and concentrated in vacuo. The residues were taken up in CH_2Cl_2 and washed with water and brine. The combined aqueous phases were extracted with CH_2Cl_2. The combined organic phases were dried ($MgSO_4$), filtered, and concentrated in vacuo. Purification by FC (silica gel) yielded the desired nucleosides **6**.

Method B. To solutions of the THP-protected nucleosides **5** (1 equiv) in MeOH (5 ml/mmol) and CH_2Cl_2 (2 ml/mmol) was added TsOH (10 mol%) and the suspensions were stirred at room temperature for 4 h. The reaction mixtures were diluted with CH_2Cl_2 and washed with sat. $NaHCO_3$ solution, water, and brine. The combined aqueous phases were extracted with CH_2Cl_2. The combined organic phases were dried ($MgSO_4$), filtered, and concentrated in vacuo. Purification by FC (silica gel) yielded the desired nucleosides **6**.

4.2.13. 4′-(2″-Deoxy-β-D-ribofuranosyl)-3,5-dinitrobiphenyl (6a). *Method A*. Yellow solid (226 mg, 0.68 mmol, 92%). R_f 0.3 (EtOAc). ^{1}H NMR (300 MHz, MeOD-d_4): δ 8.93 (t, 1H, J = 2.1, H-C(4)); 8.82 (d, 2H, J = 2.1, H-C(2); H-C(6)); 7.78 (d, 2H, J = 8.5, H(arom)) 7.60 (d, 2H, J = 8.1, H(arom)); 5.20 (dd, 1H, J_1 = 5.3, J_2 = 10.4, H-C(1″)); 4.38–4.33 (m, 1H, H-C(3″)); 3.98 (dt, 1H, J_1 = 2.3, J_2 = 5.1, H-C(4″)); 3.75–3.64 (m, 2H, 2× H-C(5″)); 2.27 (ddd, 1H, J_1 = 1.5, J_2 = 5.5, J_3 = 13.1, H-C(2″)); 2.01–1.91 (m, 1H, H-C(2″)). ^{13}C NMR (101 MHz, MeOD-d_4): δ 150.51, 145.58, 145.35, 137.19 (4s, C(arom)); 128.38, 128.26, 127.71, 117.95 (4d, C(arom)); 89.43 (d, C(4″)); 81.07 (d, C(1″)); 74.47(d, C(3″)); 64.09 (t, C(5″)); 45.09 (t, C(2″)). HR-EI-MS: *m/z* 360.0958 (M^+; $C_{17}H_{16}N_2O_7$ calcd 360.0958). IR (neat): υ_{max} 3310br, 3076w, 2944w,

2359w, 1612w, 1536s, 1513m, 1340s, 1315m, 1170w, 1081w, 1056m, 1042m, 1013m, 971w, 938w, 918m, 848w, 831m, 778w, 741m, 725s, 666m, 609m.

4.2.14. 4′-(2″-Deoxy-β-D-ribofuranosyl)-4-nitrobiphenyl (6b). *Method A*. Yellow solid (241 mg, 0.76 mmol, 96%). R_f 0.3(EtOAc). ^{1}H NMR (300 MHz, MeOD-d_4): δ 8.28 (d, 2H, J = 8.9, H-C(arom)); 7.34 (d, 2H, J = 8.9, H-C(arom)); 7.68 (d, 2H, J = 8.3, H-C(arom)); 7.53 (d, 2H, J = 8.1, H-C(arom)); 5.19 (dd, 1H, J_1 = 5.3, J_2 = 10.5, H-C(1″)); 4.38–4.32 (m, 1H, H-C(3″)); 3.70 (dt, 1H, J_1 = 2.5, J_2 = 5.1, H-C(4″)); 3.75–3.64 (m, 2H, 2× H-C(5″)); 2.25 (ddd, 1H, J_1 = 1.7, J_2 = 5.5, J_3 = 13.1, H-C(2″)); 2.02–1.91 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, MeOD-d_4): δ 148.58, 148.48, 144.46, 139.19 (4s, C(arom)); 128.82, 128.39, 127.97, 125.08 (4d, C(arom)); 89.37 (d, C(4″)); 81.17 (d, C(1″)); 74.48 (d, C(3″)); 64.11 (t, C(5″)); 45.03 (t, C(2″)). HR-EI-MS: m/z 315.1107 (M^+; $C_{17}H_{17}NO_5$ calcd 315.1107). IR (KBr): υ_{max} 3257br, 2931m, 2369w, 1596s, 1570w, 1512s, 1488s, 1474m, 1426m, 1398w, 1346s, 1282m, 1219w, 1175m, 1112m, 1090s, 1073m, 1047s, 1002s, 947m, 929w, 899w, 856s, 830s, 756s, 727m, 694m, 612w, 558w, 512w, 458w.

4.2.15. 4′-(2″-Deoxy-β-D-ribofuranosyl)-3-methoxybiphenyl (6c). *Method A*. Colorless solid (297 mg, 0.99 mmol, 94%). R_f 0.3 (EtOAc). ^{1}H NMR (300 MHz, MeOD-d_4): δ 7.57 (d, 2H, J = 8.5, H-C(arom)); 7.46 (d, 2H, J = 8.1, H-C(arom)); 7.33 (t, 1H, J = 8.1, H-C(arom)); 7.20–7.11 (m, 2H, H-C(arom)); 6.89 (ddd, 1H, J_1 = 0.9, J_2 = 2.5, J_3 = 8.2, H-C(arom)); 5.16 (dd, 1H, J_1 = 5.3, J_2 = 10.5, H-C(1″)); 4.37–4.31 (m, 1H, H-C(3″)); 3.96 (dt, 1H, J_1 = 2.5, J_2 = 5.2, H-C(4″)); 3.84 (s, 3H, –OCH_3); 3.74–3.64 (m, 2H, H-C(5″)); 2.22 (ddd, 1H, J_1 = 1.7, J_2 = 5.5, J_3 = 13.1, H-C(2″)); 2.04–1.92 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, DMSO-d_6): δ 159.90, 142.31, 141.76, 139.19 (4s, 4× C(arom)); 130.15, 126.77, 126.71, 119.13, 113.05, 112.35 (6d, 8× C(arom)); 88.01 (d, C(4″)); 79.12 (d, C(1″)); 72.67 (d, C(3″)); 62.69 (t, C(5″)); 55.28 (q, –OCH_3), 43.79 (t, C(2″)). HR-EI-MS: m/z 300.1361 (M^+; $C_{18}H_{20}O_4$ calcd 300.1362). IR (KBr): υ_{max} 3403br, 3003w, 2886m, 2838w, 1608s, 1787m, 1569m, 1522w, 1484s, 1439w, 1408m, 1344w, 1316m, 1299s, 1215s, 1173m, 1097m, 1064s, 1053s, 1028s, 1015m, 997s, 965w, 948w, 930w, 849w, 832m, 788s, 777s, 718w, 700w, 688w, 620w, 587w, 568w, 548w, 468w.

4.2.16. 4′-(2″-Deoxy-β-D-ribofuranosyl)-4-methoxybiphenyl (6d). *Method A*. Colorless solid (220 mg, 0.73 mmol, 94%) that can be recrystallized from $CHCl_3$/hexane: R_f 0.3 (EtOAc); ^{1}H NMR (300 MHz, MeOD-d_4): δ 7.53 (d, 4H, J = 7.9, H-C(arom)); 7.43 (d, 2H, J = 8.1, H-C(arom)); 6.97 (d, 2H, J = 8.9, H-C(arom)); 5.15 (dd, 1H, J_1 = 5.5, J_2 = 10.6, H-C(1″)); 4.37–4.31 (m, 1H, H-C(3″)); 3.96 (dt, 1H, J_1 = 2.5, J_2 = 5.1, H-C(4″)); 3.82 (s, 3H, –OCH_3); 3.74–3.63 (m, 2H, H-C(5″)); 2.21 (ddd, 1H, J_1 = 1.7, J_2 = 5.5, J_3 = 13.1, H-C(2″)); 2.04–1.92 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, MeOD-d_4): δ 160.79, 141.58, 141.53, 134.66 (4s, C(arom)); 128.96, 127.69, 127.49, 115.30 (4d, C(arom)); 89.25 (d, C(4″)); 81.47 (d, C(1″)); 74.53 (d, C(3″)); 64.15 (t, C(5″)); 55.79 (q, –OCH_3); 44.95 (t, C(2″)). HR-EI-MS: m/z 300.1364 (M^+; $C_{18}H_{20}O_4$ 300.1362). IR (KBr): υ_{max} 3402br, 2932w, 1607m, 1583w, 1530w, 1501s, 1459w, 1445w, 1401w, 1313w, 1289w, 1270w, 1253s, 1188m, 1090m, 1034s, 1000m, 868w, 813s, 608w, 579w, 517w.

4.2.17. 4′-(2″-Deoxy-β-D-ribofuranosyl)-3,4-dimethoxybiphenyl (6e). *Method A*. Colorless solid (226 mg, 0.68 mmol, 92%). R_f 0.3 (EtOAc). ^{1}H NMR (300 MHz, MeOD-d_4): δ 7.55 (d, 2H, J = 8.3, H-C(arom)); 7.43 (d, 2H, J = 8.3, H-C(arom)); 7.20–7.13 (m, 2H, H-C(arom)); 7.00 (d, 1H, J = 8.5, H-C(arom)); 5.15 (dd, 1H, J_1 = 5.5, J_2 = 10.5, H-C(1″)); 4.37–4.31 (m, 1H, H-C(3″)); 3.96 (dt, 1H, J_1 = 2.5, J_2 = 5.1, H-C(4″)); 3.89, 3.85 (2s, 6H, 2× –OCH_3); 3.74–3.63 (m, 2H, 2× H-C(5″)); 2.21 (ddd, 1H, J_1 = 1.7, J_2 = 5.5, J_3 = 13.1, H-C(2″)); 2.03–1.92 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, MeOD-d_4): δ 150.79, 150.24, 141.81, 141.63, 135.43 (5s, C(arom)); 127.66, 127.64, 120.57, 113.40, 112.01 (5d, C(arom)); 89.26 (d, C(4″)); 81.44 (d, C(1″)); 74.51 (d, C(3″)); 64.14 (t, C(5″)); 56.63, 56.58 (2s, 2× –OCH_3); 44.96 (t, C(2″)). HR-EI-MS: m/z 330.1468 (M^+; $C_{19}H_{22}O_5$ calcd 330.1467). IR (KBr): υ_{max} 2934m, 2884w, 2838w, 1601w, 1590m, 1564w, 1528m, 1507s, 1460m, 1439w, 1401m, 1327m, 1276m, 1250s, 1218s, 1171s, 1140s, 1102m, 1088m, 1053s, 1023s, 997w, 937w, 909w, 880w, 832m, 808s, 767m, 738w, 654w, 618w, 587w, 541w.

4.2.18. 4′-(2″-Deoxy-β-D-ribofuranosyl)-3-nitrobiphenyl (6f). *Method A*. Slightly yellow solid (329 mg, 1.04 mmol, 88%) that can be recrystallized from CH_2Cl_2/hexane. R_f 0.3 (EtOAc). ^{1}H NMR (300 MHz, MeOD-d_4): δ 8.46 (t, 1H, J = 1.9, H-C(arom)); 8.21 (ddd, 1H, J_1 = 0.9, J_2 = 2.3, J_3 = 8.3, H-C(arom)); 8.04 (ddd, 1H, J_1 = 0.9, J_2 = 1.8, J_3 = 7.8, H-C(arom)); 7.73–7.65 (m, 3H, H-C(arom)); 7.55 (d, 2H, J = 8.1, H-C(arom)); 5.19 (dd, 1H, J_1 = 5.5, J_2 = 10.6, H-C(1″)); 4.38–4.32 (m, 1H, H-C(3″)); 3.98 (dt, 1H, J_1 = 2.5, J_2 = 5.1, H-C(4″)); 3.75–3.64 (m, 2H, H-C(5″)); 2.25 (ddd, 1H, J_1 = 1.7, J_2 = 5.5; J_3 = 13.0, H-C(2″)); 2.04–1.92 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, DMSO-d_6): δ 148.64, 143.50, 141.83, 136.90 (4s, 4× C(biph)); 133.42, 130.69, 127.04, 127.00, 122.24, 121.16 (6d, 8× C(biph)); 88.09 (d, C(4″)); 79.02 (d, C(1″)); 72.65 (d, C(3″)); 62.66 (t, C(5″)); 43.82 (t, C(2″)). HR-EI-MS: m/z 315.1107 (M^+; $C_{17}H_{17}NO_5$ calcd 315.1107). IR (KBr): υ_{max} 3372br; 3089w, 3034w, 2940w, 2913m, 2887m, 1615w, 1585w, 1535s, 1517s, 1476w, 1440w, 1411w, 1361s, 1349s, 1317m, 1270m, 1231w, 1174w, 1069s, 1037m, 994m, 974m, 928w, 898w, 877w, 863w, 840m, 830m, 807m, 767m, 743m, 728m, 685m, 649w, 585w, 540w, 496w, 466w.

4.2.19. 4′-(2″-Deoxy-β-D-ribofuranosyl)-4-Fmoc-aminobiphenyl (6g). *Method B, but without extraction*. Compound **6g** is highly insoluble in any common solvent except pyridine. Therefore, the reaction mixture was just concentrated in vacuo and coevaporated with pyridine. The crude product was used for the tritylation step without further purification and characterization.

4.2.20. 4′-(2″-Deoxy-β-D-ribofuranosyl)-3-Fmoc-aminobiphenyl (6h). *Method B*. Colorless solid (249 mg, 49 mmol, 89%). R_f 0.3 (EtOAc/hexane 8:2). ^{1}H NMR (300 MHz, acetone-d_6): δ 8.97 (br, 1H, H-N); 7.88 (d, 3H, J = 7.4, H-C(arom)); 7.78–7.72 (m, 2H, H-C(arom)); 7.63–7.28 (m, 11H, H-C(arom)); 5.16 (dd, 1H, J_1 = 5.5, J_2 = 10.5, H-C(1″)); 4.52 (d, 2H, J = 6.8, H-C(Fmoc)); 4.44–4.38 (m, 1H, H-C(3″)); 4.32 (t, 1H, J = 6.8, H-C(Fmoc)); 4.23 (d, 1H, J = 3.8, –OH); 3.97 (dt, 1H, J_1 = 2.5, J_2 = 5.0, H-C(4″)); 3.85 (t, 1H, J = 5.8, –OH); 3.75–3.60 (m, 2H, H-C(5″)); 2.24 (ddd, 1H, J_1 = 1.7, J_2 = 5.4, J_3 = 12.8, H-C(2″)); 1.99–1.88 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, acetone-d_6): δ 154.46 (s, C=O); 145.01, 143.23, 142.43, 142.19, 140.69, 140.66 (6s, C(arom)); 130.17, 128.59, 127.98, 127.50, 127.43, 126.03, 122.10, 120.87, 118.16, 117.76 (10d, C(arom)); 89.18 (d, C(4″)); 80.40 (d, C(1″)); 74.18 (d, C(3″)); 67.07, 64.06 (2t, C(5″), C(Fmoc)); 48.01 (d, C(Fmoc)); 45.14 (t, C(2″)). HR-ESI$^+$-MS: m/z 508.2143 ([M+Na]$^+$; $C_{32}H_{29}NO_5Na$ calcd 508.2123). IR (KBr): υ_{max} 3423br, 3320s, 3065w, 2917w, 2878w, 1697s, 1611m, 1547s, 1519w, 1490m, 1462w, 1451m, 1434m, 1399w, 1313m, 1290m, 1274m, 1249s, 1230s, 1103m, 1093m, 1062m, 1040m, 945w, 899w, 878w, 831w, 793m, 761m, 740s, 713w, 694w, 647w, 622w, 586w, 548w.

4.2.21. General procedure for DMT-protection. The nucleosides **6** (1 equiv) were coevaporated with pyridine (3×) and dissolved in pyridine (4 ml/mmol). DMT-Cl was added in portions over 2 h (4 × 0.3 equiv). After another 90 min at room temperature, the mixtures were diluted with EtOAc and washed with sat. $NaHCO_3$ solution. The combined aqueous phases were extracted with EtOAc. The combined organic phases were dried ($MgSO_4$), filtered, and concentrated in vacuo. The residues were coevaporated with toluene. Purification by FC (silica gel) yielded the desired tritylated compounds **7**.

4.2.22. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-β-D-ribofuranosyl]-3,5-dinitrobiphenyl (7a). Orange foam (580 mg, 0.88 mmol, 95%). R_f 0.3 (hexane/EtOAc 1:1 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.00 (t, 1H, J = 2.1, H-C(arom)); 8.75 (d, 2H, J = 2.1, H-C(arom)); 7.64 (d, 2H, J = 8.5, H-C(arom)); 7.60 (d, 2H, J = 8.3, H-C(arom)); 7.51–7.44 (m, 2H, H-C(arom)); 7.40–7.18 (m, 7H, H-C(arom)); 6.83 (d, 4H, J = 8.9, H-C(arom)); 5.26 (dd, 1H, J_1 = 5.7, J_2 = 10.2, H-C(1″)); 4.51–4.45 (m, 1H, H-C(3″)); 4.15–4.08 (m, 1H, H-C(4″)); 3.79 (s, 6H, CH_3O-DMT); 3.43–3.28 (m, 2H, 2× H-C(5″)); 3.35 (ddd, 1H, J_1 = 2.1, J_2 = 5.7, J_3 = 13.0); 2.13–2.02 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.55, 148.99, 144.82, 144.58, 144.22, 135.97, 135.48 (7s, C(arom)); 130.12, 128.21, 127.88, 127.21, 127.18, 126.87, 126.80, 117.04, 113.17 (9d, C(arom)); 86.59 (d, C(4″)); 86.32 (s, $C(Ph)_3$DMT); 79.39 (d, C(1″)); 74.55 (d, C(3″)); 64.38 (t, C(5″)); 55.24 (q, CH_3O-DMT); 43.99 (t, C(2″)). HR-ESI$^+$-MS: m/z 685.2144 ([M+Na]$^+$; $C_{38}H_{34}N_2O_9Na$ calcd 685.2162). IR (neat): υ_{max} 2932w, 1607w, 1539s, 1507s, 1444w, 1344s, 1299w, 1247s, 1174s, 1078m, 1032s, 953w, 906w, 826s, 791w, 777w, 755w, 727s, 701m, 669w, 635w.

4.2.23. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-β-D-ribofuranosyl]-4-nitrobiphenyl (7b). Yellow foam (436 mg, 0.71 mmol, 92%). R_f 0.4 (hexane/EtOAc 1:1 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.28 (d, 2H, J = 8.9, H(arom)); 7.72 (d, 2H, J = 8.9, H(arom)); 7.60 (d, 2H, J = 8.3, H(arom)); 7.53–7.45 (m, 6H, H(arom)); 7.40–7.17 (m, 7H, H(arom)); 6.83 (d, 4H, J = 8.9, H(arom)); 5.24 (dd, J_1 = 5.7, J_2 = 10.2, 1H, H-C(1″)); 4.49–4.43 (m, 1H, H-C(3″)); 4.14–4.07 (m, 1H, H-C(4″)); 3.78 (s, 6H, 2× CH_3O-DMT); 3.41–3.28 (m, 2H, H-C(5″)); 2.30 (ddd, J_1 = 2.1, J_2 = 5.6, J_3 = 13.1, 1H, H-C(2″)); 2.13–2.02 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.53, 147.33, 147.07, 144.85, 142.99, 137.91, 136.03, 136.02 (8s, C(arom)); 130.12, 128.21, 127.85, 127.68, 127.37, 126.84, 126.78, 124.12, 113.16 (9d, C(arom)); 86.50 (d, C(4″)); 86.30 (s, $C(Ph)_3$DMT); 79.55 (d, C(1″)); 74.64 (d, C(3′)); 64.44 (t, C(5″)); 55.22 (q, CH_3O-DMT); 43.91 (t, C(2″)). HR-ESI$^+$-MS: m/z 640. 2277 ([M+Na]$^+$; $C_{38}H_{35}NO_7Na$ calcd 640.2311). IR (KBr): υ_{max} 2932w, 2837w, 1735w, 1605m, 1510s, 1464w, 1446w, 1397w, 1343s, 1302m, 1251s, 1177s, 1111m, 1082m, 1034s, 856w, 827s, 791w, 757m, 727w, 700w, 584w.

4.2.24. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-β-D-ribofuranosyl]-3-methoxybiphenyl (7c). Colorless foam (420 mg, 0.70 mmol, 90%). R_f 0.3 (hexane/EtOAc 1:1 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.54 (d, 2H, J = 8.5, H(arom)); 7.51–7.41 (m, 4H, H(arom)); 7.40–7.13 (m, 9H, H(arom)); 7.11 (t, 1H, J = 2.5, H(arom)); 6.89 (ddd, 1H, J_1 = 1.0, J_2 = 2.6, J_3 = 10.4, H(arom)); 6.82 (d, 4H, J = 9.0, H(arom)); 5.22 (dd, 1H, J_1 = 5.7, J_2 = 10.0, H-C(1″)); 4.49–4.41 (m, 1H, H-C(3″)); 4.12–4.04 (m, 1H, H-C(4″)); 3.86 (s, 3H, –OCH_3); 3.78 (s, 6H, 2× (DMT)-OCH_3); 3.38 (dd, 1H, J_1 = 4.5, J_2 = 9.6, H-C(5″)); 3.29 (dd, 1H, J_1 = 5.5, J_2 = 9.5, H-C(5″)); 2.28 (ddd, 1H, J_1 = 2.1, J_2 = 5.8, J_3 = 13.1, H-C(2″)); 2.14–2.03 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 159.95, 158.51, 144.87, 142.48, 141.08, 140.35, 136.06 (7s, C(arom)); 130.11, 129.74, 128.22, 127.85, 127.15, 126.81, 126.44, 119.62, 113.16, 112.84, 112.66 (11d, C(arom)); 86.35 (d, C(4″)); 86.26 (s, $C(Ph)_3$DMT); 79.76 (d, C(1″)); 74.75 (d, C(3″)); 64.52 (t, C(5″)); 55.31, 55.21 (2q, 2× –OCH3); 43.83 (t, C(2″)). HR-ESI$^+$-MS: m/z 625.2589 ([M+Na]$^+$; $C_{39}H_{38}O_6Na$ calcd 625.2566). IR (neat): υ_{max} 2932w, 2835w, 1606m, 1507m, 1482w, 1445w, 1404w, 1297m, 1248s, 1219m, 1174s, 1080m, 1031s, 951w, 826s, 778m, 745w, 727w, 699m, 634w, 602w.

4.2.25. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-β-D-ribofuranosyl]-4-methoxybiphenyl (7d). Colorless foam (420 mg, 0.70 mmol, 90%). R_f 0.4 (hexane/EtOAc 1:1 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.54–7.17 (m, 15H, H(arom)); 6.97 (d, 2H, J = 8.9, H(arom)); 6.82 (d, 4H, J = 8.9, H(arom)); 5.21 (dd, J_1 = 5.7, J_2 = 10.0, 1H, H-C(1″)); 4.48–4.41 (m, 1H, H-C(3″)); 4.11–4.05 (m, 1H, H-C(4″)); 3.85 (s, 3H, CH_3O–); 3.78 (s, 6H, 2× CH_3O-DMT); 3.41–3.25 (m, 2H, H-C(5″)); 2.27 (ddd, J_1 = 2.1, J_2 = 5.7, J_3 = 13.1, 1H, H-C(2″)); 2.14–2.03 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 159.15, 158.50, 144.88, 140.22, 140.10, 136.08, 133.50 (7s, C(arom)); 130.12, 128.24, 128.08,

127.85, 126.80, 126.66, 126.48, 114.22, 113.16 (9d, C(arom)); 86.34 (d, C(4″)); 86.27 (s, $C(Ph)_3$DMT); 79.82 (d, C(1″)); 74.74(d, C(3′)); 64.55 (t, C(5″)); 55.35, 55.22 (2q, 3× CH_3O-); 43.80 (t, C(2″)). HR-ESI$^+$-MS: *m*/*z* 625.2579 ([M+Na]$^+$; $C_{39}H_{38}O_6Na$ calcd 625.2566). IR (KBr): υ_{max} 2932w, 2836w, 1736w, 1609m, 1583w, 1509s, 1464m, 1444m, 1295m, 1250s, 1177s, 1081m, 1037s, 1001m, 953w, 822m, 755w, 727w, 703w, 583w, 527w.

4.2.26. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-β-D-ribofuranosyl]-3,4-dimethoxybiphenyl (7e). Colorless foam (525 mg, 0.83 mmol, 90%). R_f 0.3 (hexane/EtOAc 1:1 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.54–7.40 (m, 6H, H-C(arom)); 7.37 (dd, 2H, J_1 = 1.5, J_2 = 9.0, H-C(arom)); 7.33–7.17 (m, 3H, H-C(arom)); 7.12 (dt, 2H, J_1 = 2.1, J_2 = 8.1, H-C(arom)); 6.94 (d, 1H, *J* = 8.5, H-C(arom)); 6.83 (d, 4H, *J* = 8.9, H-C(arom)); 5.21 (dd, 1H, J_1 = 5.7, J_2 = 10.0, H-C(1″)); 4.49–4.42 (m, 1H, H-C(4″)); 4.12–4.05 (m, 1H, C(3″)); 3.94, 3.92 (2s, 6H, –OCH_3); 3.78 (s, 6H, (DMT)-OCH_3); 2.32–2.23 (m, 2H, 2× H-C(5″)); 2.28 (ddd, 1H, J_1 = 2.1, J_2 = 5.7; J_3 = 13.1, H-C(2″)); 2.15–2.03 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.50, 149.17, 148.63, 144.45, 140.45, 140.33, 136.08, 133.99 (8s, C(arom)); 130.12, 128.22, 127.85, 126.80, 126.46, 119.35, 113.15, 111.52, 110.45 (9d, C(arom)); 86.35 (d, C(4″)); 86.24 (s, $C(Ph)_3$DMT); 79.78 (d, C(1″)); 74.74 (d, C(3″)); 64.51 (t, C(5″)); 56.00, 55.96, 55.21 (3s, 3× –OCH3); 43.86 (t, C(2″)). HR-ESI$^+$-MS: *m*/*z* 655.2680 ([M+Na]$^+$; $C_{40}H_{40}O_7Na$ calcd 655.2671). IR (neat): υ_{max} 2932w, 2835w, 1733w, 1606w, 1503s, 1444w, 1400w, 1300w, 1246s, 1217m, 1173s, 1143m, 1080m, 1027s, 953w, 882w, 827s, 806s, 764m, 727w, 702m.

4.2.27. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-β-D-ribofuranosyl-3-nitrobiphenyl (7f). Yellow foam (576 mg, 0.93 mmol, 90%). R_f 0.3 (hexane/EtOAc 1:1 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.45 (t, *J* = 2.1, 1H, H(biph)); 8.24–8.7 (m, 1H, H(biph)); 7.94–7.88 (m, 1H, H(biph)); 7.61 (t, *J* = 8.1, 3H, H(biph)); 7.50 (m, 4H, H(biph), H(arom)); 7.41–7.19 (m, 7H, H(arom)); 6.84 (d, *J* = 8.9, 4H, H(arom)); 5.26 (dd, J_1 = 5.7, J_2 = 10.0, 1H, H-C(1″)); 4.51–4.45 (m, 1H, H-C(3″)); 4.15–4.08 (m, 1H, H-C(4″)); 3.80 (s, 6H, 2× CH_3O-DMT); 3.40 (dd, J_1 = 4.5, J_2 = 9.8, 1H, H-C(5″)); 3.32 (dd, J_1 = 5.5, J_2 = 9.8, 1H, H-C(5″)); 2.32 (ddd, J_1 = 1.9, J_2 = 5.7, J_3 = 13.1, 1H, H-C(2″)); 2.15–2.04 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.48, 148.71, 144.80, 142.56, 142.45, 137.83, 135.97 (7s, C(biph), C(arom)); 132.94, 130.08, 129.70, 128.17, 127.85, 127.13, 126.82, 126.79 (8d, C(biph), C(arom)); 86.41 (d, C(4″)); 86.25 (s, $C(Ph)_3$DMT); 79.56 (d, C(1″)); 74.68 (d, C(3′)); 64.41 (t, C(5″)); 55.20 (q, CH_3O-DMT); 43.89 (t, C(2″)). HR-ESI$^+$-MS: *m*/*z* 640.2292 ([M+Na]$^+$; $C_{38}H_{35}NO_7Na$ calcd 640.2311). IR (KBr): υ_{max} 3036w, 2932m, 2837w, 1735w, 1609m, 1583w, 1533s, 1510s, 1464m, 1446m, 1412w, 1350s, 1302m, 1251s, 1177s, 1156w, 1083s, 1034s, 953w, 902w, 877w, 830s, 805m, 903w, 877w, 830s, 806m, 792w, 756w, 744w, 727m, 703w, 683w, 636w, 585m.

4.2.28. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-β-D-ribofuranosyl]-4-Fmoc-aminobiphenyl (7g). Colorless foam (469 mg, 0.51 mmol, 82%). R_f 0.4 (hexane/EtOAc 1:1 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.77 (d, 2H, *J* = 7.5, H(arom)); 7.61 (d, 2H, *J* = 7.4, H(arom)); 7.54–7.16 (m 21H, H(arom)); 6.85–6.74 (m, 5H, H(arom), –NH–); 5.20 (dd, J_1 = 5.5, J_2 = 10.0, 1H, H-C(1″)); 4.56 (d, 2H, *J* = 6.6, H-Fmoc); 4.46–4.40 (m, 1H, H-C(3″)); 4.27 (t, 1H, *J* = 6.4, H-Fmoc); 4.11–4.04 (m, 1H, H-C(4″)); 3.76 (s, 6H, 2× CH_3O-DMT); 3.40–3.25 (m, 2H, H-C(5″)); 2.26 (ddd, J_1 = 2.1, J_2 = 5.7, J_3 = 13.1, 1H, H-C(2″)); 2.13–2.01 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.50, 153.41, 144.88, 143.74, 141.38, 140.66, 139.73, 136.98, 136.19, 136.07 (10s, C(arom)); 130.11, 128.23, 127.84, 127.81, 127.59, 126.80, 127.15 126.71, 126.52, 124.93, 120.06, 119.16, 113.16 (13d, C(arom)); 86.35 (d, C(4″)); 86.26 (s, $C(Ph)_3$DMT); 79.77 (d, C(1″)); 74.72 (d, C(3′)); 64.84, 64.54 (2t, C(5″), C(Fmoc)); 55.21 (q, CH_3O-DMT); 47.17 (d, C(Fmoc)); 43.81 (t, C(2″)). HR-ESI$^+$-MS: *m*/*z* 832.3239 ([M+Na]$^+$; $C_{53}H_{47}NO_7Na$ calcd 832.3250). IR (KBr): υ_{max} 2933w, 2836w, 1734s, 1608s, 1534s, 1509s, 1448m, 1420w, 1374w, 1318m, 1301m, 1251s, 1216s, 1177s, 1077s, 1034s, 824m, 791w, 824m, 758m, 741m, 702w, 621w, 585w, 545w.

4.2.29. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-β-D-ribofuranosyl]-3-Fmoc-aminobiphenyl (7h). Colorless foam (376 mg, 0.46 mmol, 96%). R_f 0.4 (hexane/EtOAc 1:1 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.77 (d, 2H, *J* = 7.5, H(arom)); 7.65–7.16 (m 23H, H(arom)); 6.85–6.77 (m, 5H, H(arom), –NH–); 5.20 (dd, J_1 = 5.7, J_2 = 10.0, 1H, H-C(1″)); 4.55 (d, 2H, *J* = 6.6, H-Fmoc); 4.46–4.40 (m, 1H, H-C(3″)); 4.27 (t, 1H, *J* = 6.6, H-Fmoc); 4.11–4.04 (m, 1H, H-C(4″)); 3.76 (s, 6H, 2× CH_3O-DMT); 3.40–3.25 (m, 2H, H-C(5″)); 2.26 (ddd, J_1 = 1.9, J_2 = 5.7, J_3 = 13.2, 1H, H-C(2″)); 2.12–2.01 (m, 1H, H-C(2″)). ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.47, 153.39, 144.83, 143.72, 141.88, 141.35, 141.17, 139.87, 138.12, 136.05 (10s, C(arom)); 130.10, 130.08, 129.44, 128.20, 127.82, 127.77, 127.09, 126.79, 126.43, 124.91, 122.35, 120.03, 117.53, 113.14 (15d, C(arom)); 86.32 (d, C(4″)); 86.25 (s, $C(Ph)_3$DMT); 79.70 (d, C(1″)); 74.69 (d, C(3′)); 64.81, 64.48 (2t, C(5″), C(Fmoc)); 55.22 (q, CH_3O-DMT); 47.15 (d, C(Fmoc)); 43.78 (t, C(2″)). HR-ESI$^+$-MS: *m*/*z* 832.3256 ([M+Na]$^+$; $C_{53}H_{47}NO_7Na$ calcd 832.3250). IR (KBr): υ_{max} 2933w, 2836w, 1735s, 1609s, 1543m, 1509s, 1446m, 1404w, 1374w, 1301w, 1250s, 1211s, 1177s, 1080s, 1036s, 903w, 830m, 790w, 758w, 741m, 700w, 585w, 543w.

4.3. General procedure for phosphitylation

Method A. To solutions of the DMT-protected nucleosides **7** (1 equiv) in dry THF (25 ml/mmol) were added *N*,*N*-diisopropylethylamine (3 equiv) followed by 2-cyanoethyl-diisopropylchlorophosphoramidite (1.5 equiv) at room temperature. After 2 h (TLC control), EtOAc was added and the organic phases were washed with cold, sat. $NaHCO_3$ solution. The combined aqueous phases were extracted with EtOAc. The combined organic phases were dried ($MgSO_4$), filtered, and con-

centrated in vacuo. Purification by FC (silica gel) yielded the desired phosphoramidites **8**.

Method B. The DMT-protected nucleosides **7** (1 equiv) and diisopropylammonium-1*H*-tetrazol-1-ide (2.2 equiv) were dried by coevaporation with dry benzene and dissolved in dry CH_2Cl_2 (40 ml/mmol). *N*,*N*,*N*′,*N*′-tetraisopropyl-phosphordiamidite (2 equiv) was added and the mixtures were stirred at room temperature for 16 h. The mixtures were concentrated in vacuo. Purification by FC (silica gel) yielded the desired phosphoramidites **8**.

4.3.1. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-3″-*O*-(2-cyanoethyl-*N*,*N*′-diisopropylaminophosphino)-β-D-ribofuranosyl]-3,5-dinitrobiphenyl (8a). *Method B*. Orange foam (104 mg, 0.12 mmol, 80%). R_f 0.45 (hexane/EtOAc 7:3). ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.00 (t, 1H, J = 2.1, H-C(arom)); 8.76 (d, 2H, J = 2.1, H-C(arom)); 7.68–7.57 (m, 4H, H-C(arom)); (m, 2H, H-C(arom)); 7.41–7.33 (m, 4H, H-C(arom)); 7.31–7.18 (m, 3H, H-C(arom)); 6.82 (dd, 4H, J_1 = 3.4, J_2 = 8.9, H-C(arom)), 5.26 (ddd, 1H, J_1 = 1.9, J_2 = 5.1, J_3 = 10.4, H-C(1″)); 4.57 (dd, 1H, J_1 = 6.0, J_2 = 10.4, H-C(3″)); 4.34–4.24 (m, 1H, H-C(4″)); 3.92–3.52 (m, 4H, CH_2OP, 2× CH—*i*Pr); 3.79, 3.78 (2s, 6H, 2× O-CH_3); 3.44–3.23 (m, 2H, 2× H-C(5″)); 2.63 (t, 1H, J = 6.3, CH_2CN); 2.55–2.36 (m, 2H, CH_2CN, H-C(2″)); 2.13–2.00 (m, 1H, H-C(2″)); 1.28–1.06 (m, 12H, 4× CH_3-*i*Pr). ^{31}P NMR (162 MHz, $CDCl_3$): δ 148.23, 148.20. ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.49, 158.47, 148.96, 144.85, 144.82, 144.62, 144.59, 144.11, 144.08, 136.06, 136.03, 135.99, 135.98, 135.50, 135.43 (15s, C(arom)); 130.18, 130.14, 128.28, 128.24, 127.81, 127.26, 127.21, 127.18, 126.82 (9d, C(arom)); 117.58, 117.49 (2s, CN); 117.04, 117.02, 113.10 (3d, C(arom)); 86.30, 86.25, 85.99, 86.91 (4d, C(4″)); 86.17, 85.99 (2s, C(Ph)$_3$DMT); 79.74, 79.68 (2d, C(1″)); 76.31, 76.08, 75.80, 75.58 (4d, C(4″)); 64.09, 64.04 (2t, C(5″)); 58.44, 58.40, 58.19, 58.14 (4t, CH_2–OP); 55.25, 55.23 (2q, 2× –OCH_3); 43.44, 43.39 (2t, C(2″)); 43.31, 43.27, 43.15, 43.11 (4d, CH—*i*Pr); 24.69, 24.59, 24.56, 24.46, 24.44 (5q, CH_3-*i*Pr); 20.46, 20.37, 20.28, 20.19 (4t, CH_2–CN). HR-ESI$^+$-MS: *m*/*z* 863.3451 ([M+H]$^+$; $C_{47}H_{51}N_4O_{10}$PNa calcd 863.3421). IR (KBr): υ_{max} 2968m, 2933m, 2254w, 1609m, 1545s, 1510s, 1464m, 1447w, 1397w, 1347s, 1301m, 1251s, 1202w, 1179s, 1156w, 1127w, 1077s, 1035s, 978m, 908w, 830m, 791w, 776w, 756w, 730m, 704w, 585w, 525w.

4.3.2. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-3″-*O*-(2-cyanoethyl-*N*,*N*′-diisopropylaminophosphino)-β-D-ribofuranosyl]-4-nitrobiphenyl (8b). *Method A*. Slightly yellow foam (242 mg, 0.30 mmol, 74%). R_f 0.4 (hexane/EtOAc 8:2). ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.29 (d, 2H, J = 8.9, H-C(arom)); 7.73 (d, 2H, J = 8.9, H-C(arom)); 7.62–7.45 (m, 6H, H-C(arom)); 7.41–7.17 (m, 7H, H-C(arom)); 6.85–6.78 (m, 4H, H-C(arom)); 5.27–5.19 (m, 1H, H-C(1″)); 4.60–4.51 (m 1H, H-C(3″)); 4.31–4.22 (m, 1H, H-C(4″)); 3.91–3.52 (m, 4H, CH_2OP, 2× CH—*i*Pr); 3.79, 3.78 (2s, 6H, 2× O—CH_3); 3.41–3.23 (m, 2H, 2× H-C(5″)); 2.63 (t, 1H, J = 6.4, CH_2CN); 2.47 (t, 1H, J = 6.4, CH_2CN); 2.52–2.34 (m, 1H, H-C(2″)); 2.13–2.00 (m, 1H, H-C(2″)); 1.32–1.07 (m, 12H, 4× CH_3—*i*Pr). ^{31}P NMR (162 MHz, $CDCl_3$): δ 148.23, 148.14. ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.49, 147.40, 147.35, 147.06, 144.90, 144.87, 142.92, 142.89, 137.94, 137.88, 136.13, 136.10, 136.05 (13s, C(arom)); 130.19, 130.15, 128.32, 128.28, 127.80, 127.70, 127.38, 127.35, 126.85, 126.80, 126.76, 124.12 (12d, C(arom)); 117.54 (1s, CN); 113.10 (1d, C(arom)); 86.23, 86.18, 85.92, 85.84 (4d, C(4″)); 86.17 (s, C(Ph)$_3$DMT); 79.91, 79.84 (2d, C(1″)); 76.37, 76.14, 75.89, 75.67 (4d, C(3″)); 64.15, 64.11 (2t, C(5″)); 58.47, 58.43, 58.22, 58.18 (4t, CH_2–OP); 55.22 (1s, 2× —OCH_3); 43.40, 43.29 (2t, C(2″)); 43.18, 43.29 (2d, CH—*i*Pr); 24.68, 24.59 24.54, 24.44 (4q, CH_3-*i*Pr); 20.45, 20.35, 20.28, 20.18 (4t, CH_2–CN). HR-ESI$^+$-MS: *m*/*z* 40.3401 ([M+H]$^+$; $C_{47}H_{52}N_3O_8$PNa calcd 840.3389). IR (KBr): υ_{max} 2968s, 2933m, 2838w, 2254w, 1608s, 1511s, 1464m, 1447m, 1397w, 1365m, 1343s, 1303m, 1252s, 1202w, 1179s, 1156w, 1111m, 1076s, 1034s, 1005s, 978s, 894w, 856w, 828s, 791m, 758m, 727m, 701m, 641w, 584w, 523w.

4.3.3. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-3″-*O*-(2-cyanoethyl-*N*,*N*′-diisopropylaminophosphino)-β-D-ribofuranosyl]-3-methoxybiphenyl (8c). *Method A*. Colorless foam (606 mg, 0.75 mmol, 84%). R_f 0.30, 0.35 (hexane/EtOAc 8:2). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.55 (d, 2H, J = 8.1, H-C(arom)); 7.52–7.45 (m, 4H, H-C(arom)); 7.41–7.10 (m, 10H, H-C(arom)); 6.89 (ddd, 1H, J_1 = 0.8, J_2 = 2.5, J_3 = 8.2, H-C(arom)); 6.82 (dd, 4H, J_1 = 3.8, J_2 = 9.0, H-C(arom)); 5.21 (ddd, 1H, J_1 = 1.9, J_2 = 5.0, J_3 = 10.5, H-C(1″)); 4.54 (dd, 1H, J_1 = 5.8, J_2 = 10.7, H-C(3″)); 4.29–4.21 (m, 1H, H-C(4″)); 3.90–3.50 (m, 4H, CH_2OP, 2× CH—*i*Pr); 3.86, 3.78, 3.77 (3s, 9H, 3× O-CH_3); 3.39–3.22 (m, 2H, 2× H-C(5″)); 2.62 (t, 1H, J = 6.6, CH_2CN); 2.47 (t, 1H, J = 6.6, CH_2CN); 2.46–2.31 (m, 1H, H-C(2″)); 2.14–2.01 (m, 1H, H-C(2″)); 1.22–1.04 (m, 12H, 4× CH_3-*i*Pr). ^{31}P NMR (162 MHz, $CDCl_3$): δ 148.20, 148.00. ^{13}C NMR (75 MHz, $CDCl_3$): δ 159.92, 158.43, 144.91, 144.89, 142.50, 142.48, 140.97, 140.93, 140.35, 140.29, 136.14, 136.10 (12s, C(arom)); 130.18, 130.17, 130.14, 129.74, 128.31, 128.27, 127.78, 127.14, 127.12, 126.76, 126.72, 126.52, 119.61 (13d, C(arom)); 117.55, 117.50 (2s, CN); 113.07, 112.80, 112.65 (3d, C(arom)); 86.11, 86.05, 85.78, 85.70 (4d, C(4″)); 86.08 (s, C(Ph)$_3$DMT); 80.13, 80.06 (2d, C(1″)); 76.38, 76.15, 75.96, 75.73 (4d, C(3″)); 64.21, 64.17 (2t, C(5″)); 58.46, 58.44, 58.21, 58.19 (4t, CH_2–OP); 55.31, 55.22, 55.20 (3s, 3× –OCH_3); 43.33 (t, C(2″)); 43.29, 43.25, 43.12, 43.08 (4d, CH—*i*Pr); 24.69, 24.67, 24.59, 24.58, 24.51, 24.42 (6q, CH_3-*i*Pr); 20.41, 20.32, 20.25, 20.16 (4t, CH_2–CN). HR-ESI$^+$-MS: *m*/*z* 803.3833 ([M+H]$^+$; $C_{48}H_{55}N_2O_7$PNa calcd 803.3825). IR (KBr): υ_{max} 2967m, 2933m, 2837w, 2253w, 1609s, 1585m, 1568w, 1510s, 1483m, 1465m, 1447m, 1398w, 1365m, 1298m, 1252s, 1221m, 1202w, 1179s, 1157m, 1126w, 1076s, 1054s, 1033s, 978s, 879w, 829s, 790m, 755m, 727m, 699m, 641w, 584w, 523w.

4.3.4. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-3″-*O*-(2-cyanoethyl-*N*,*N*′-diisopropylaminophosphino)-β-D-ribofuranosyl]-4-methoxybiphenyl (8d). *Method A*. Colorless foam (273 mg, 0.34 mmol, 64%). R_f 0.4 (hexane/EtOAc 8:2). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.55–

7.43 (m, 8H, H-C(arom)); 7.41–7.33 (m, 4H, H-C(arom)); 7.31–7.16 (m, 3H, H-C(arom)); 6.97 (d, 2H, J = 8.7, H-C(arom)); 6.85–6.78 (m, 4H, H-C(arom)); 5.24–5.16 (m, 1H, H-C(1″)); 4.59–4.49 (m 1H, H-C(3″)); 4.29–4.21 (m, 1H, H-C(4″)); 3.91–3.51 (m, 4H, CH_2OP, 2× CH—*i*Pr); 3.84, 3.78, 3.77 (3s, 9H, 3× O-CH_3); 3.38–3.22 (m, 2H, 2× H-C(5″)); 2.61 (t, 1H, J = 6.6, CH_2CN); 2.47 (t, 1H, J = 6.6, CH_2CN); 2.46–2.31 (m, 1H, H-C(2″)); 2.14–2.01 (m, 1H, H-C(2″)); 1.31–1.04 (m, 12H, 4× CH_3-*i*Pr). ^{31}P NMR (162 MHz, $CDCl_3$): δ 148.20, 147.98. ^{13}C NMR (75 MHz, $CDCl_3$): δ 159.12, 158.42, 144.91, 140.10, 140.07, 140.04, 136.14, 136.10, 135.51, 133.48 (10s, C(arom)); 130.13, 128.30, 128.26, 128.06, 127.75, 126.72, 126.68, 126.63, 126.61, 126.51 (10d, C(arom)); 117.48, 117.45 (2s, CN); 114.18, 113.06 (2d, C(arom)); 86.09, 86.06, 85.99, 85.65 (4d, C(4″)); 86.08 (s, C(Ph)$_3$DMT); 80.13, 80.07 (2d, C(1″)); 76.39, 76.16, 75.97, 75.76 (4d, C(3″)); 64.23, 64.18 (2t, C(5″)); 58.46, 58.44, 58.21, 58.17 (4t, CH_2–OP); 55.31, 55.19 (2s, 3× –OCH_3); 43.26 (t, C(2″)); 43.14, 43.10 (2d, CH—*i*Pr); 24.66, 24.55 24.48, 24.39 (4q, CH_3-*i*Pr); 20.41, 20.29, 20.23, 20.13 (4t, CH_2–CN). HR-ESI$^+$-MS: *m*/*z* 803.3844 ([M+H]$^+$; $C_{48}H_{55}N_2O_7PNa$ calcd 803.3825). IR (KBr): υ_{max} 2967m, 2932m, 2837w, 2253w, 1609s, 1583w, 1509s, 1464m, 1446w, 1397w, 1365w, 1294m, 1250s, 1178s, 1156m, 1076s, 1037s, 1001m, 977m, 893w, 823s, 791w, 755w, 727w, 702m, 635w, 583w, 524w.

4.3.5. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-3″-*O*-(2-cyanoethyl-*N*,*N*′-diisopropylaminophosphino)-β-D-ribofuranosyl]-3,4-dimethoxybiphenyl (8e). *Method A*. Colorless foam (577 mg, 0.69 mmol, 84%). R_f 0.55, 0.50 (hexane/EtOAc 6:4). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.55–7.44 (m, 6H, H-C(arom)); 7.42–7.34 (m, 4H, H-C(arom)); 7.32–7.09 (m, 5H, H-C(arom)); 6.94 (d, 1H, J = 8.3, H-C(arom)); 6.82 (dd, 4H, J_1 = 3.7, J_2 = 8.9, H-C(arom)); 5.21 (ddd, 1H, J_1 = 2.1, J_2 = 5.0, J_3 = 10.5, H-C(1″)); 4.55 (dd, 1H, J_1 = 6.0, J_2 = 10.8, H-C(3″)); 4.29–4.22 (m, 1H, H-C(4″)); 3.95, 3.92, 3.87, 3.77 (4s, 12H, 4× O-CH_3); 3.92–3.50 (m, 4H, CH_2OP, 2× CH—*i*Pr); 3.40–3.21 (m, 2H, 2× H-C(5″)); 2.62 (t, J = 6.3, 1H, CH_2CN); 2.50–2.32 (m, 2H, CH_2CN, H-C(2″)); 2.15–2.02 (m, 1H, H-C(2″)); 1.22–1.05 (m, 12H, 4× CH_3-*i*Pr). ^{31}P NMR (162 MHz, $CDCl_3$): δ 148.18, 148.00. ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.42, 149.13, 148.58, 148.57, 144.93, 144.90, 140.34, 140.32, 140.26, 136.16, 136.13 136.10, 136.08, 134.00, 133.96 (15s, C(arom)); 130.18, 130.14, 128.31, 128.27, 127.78, 126.80, 126.78, 126.71, 126.54, 119.32 (10d, C(arom)); 117.55, 117.50 (2s, CN); 113.55, 111.45, 110.38 (3d, C(arom)); 86.08, 86.06, 85.76, 85.69 (4d, C(4″)); 86.07, 86.04 (2s, C(Ph)$_3$DMT); 80.15, 80.07 (2d, C(1″)); 76.37, 76.14, 75.93, 75.72 (4d, C(3″)); 64.18, 64.14 (2t, C(5″)); 58.46, 58.43, 58.21, 58.18 (4t, CH_2–OP); 55.99, 55.95, 55.21 (3s, 4× –OCH_3); 43.39, 43.33 (2t, C(2″)); 43.29, 43.25, 43.13, 43.09 (4d, CH—*i*Pr); 24.69, 24.67, 24.59, 24.58, 24.42, 24.41 (6q, CH_3-*i*Pr); 20.41, 20.32, 20.25, 20.16 (4t, CH_2–CN). HR-ESI$^+$-MS: *m*/*z* 855.3754 ([M+Na]$^+$; $C_{49}H_{57}N_2O_8PNa$ calcd 855.3750). IR (KBr): υ_{max} 2967m, 2934m, 2837w, 2253w, 1609m, 1590w, 1528w, 1508s, 1465m, 1447m, 1398w, 1365w, 1327w, 1302m, 1252s, 1219m, 1202w, 1176s, 1144m, 1126w, 1075m, 1030s, 978m, 882w, 830m, 808m, 791w, 766w, 756w, 727w, 702w, 584w, 524w.

4.3.6. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-3″-*O*-(2-cyanoethyl-*N*,*N*′-diisopropylaminophosphino)-β-D-ribofuranosyl]-3-nitrobiphenyl (8f). Method A Colorless foam (537 mg, 0.66 mmol, 89%). R_f 0.45, 0.50 (hexane/EtOAc 7:3). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.49–8.43 (m, 1H, H-C(arom)); 8.24–8.15 (m, 1H, H-C(arom)); 7.96–7.87 (m, 1H, H-C(arom)); 7.67–7.44 (m, 7H, H-C(arom)); 7.42–7.33 (m, 4H, H-C(arom)); 7.33–7.17 (m, 3H, H-C(arom)); 6.88–6.77 (m, 4H, H-C(arom)); 5.24 (ddd, J_1 = 1.9, J_2 = 5.0, J_3 = 10.4, 1H, H-C(1″)); 4.62–4.52 (dd, J_1 = 5.7, J_2 = 10.8, 1H, H-C(3″)); 4.32–4.24 (m, 1H, H-C(4″)); 3.93–3.53 (m, 4H, CH_2OP, 2× CH—*i*Pr), 3.80, 3.79 (2s, 6H, 2× O-CH_3); 3.43–3.24 (m, 2H, H-C(5″)); 2.64 (dt, J_1 = 0.4, J_2 = 6.3, 1H, CH_2CN); 2.54–2.35 (m, 2H, CH_2CN, H-C(2″)); 2.15–2.03 (m, 1H, H-C(2″)); 1.23–1.06 (m, 12H, 4× CH_3-*i*Pr). ^{31}P NMR (162 MHz, $CDCl_3$): δ 148.22, 148.09. ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.42, 148.71, 144.85, 144.82, 142.61, 142.58, 142.39, 142.36, 137.84, 137.79, 136.08, 136.05, 136.00 (13s, C(arom)); 132.97, 130.15, 130.12, 129.70, 128.27, 128.23, 127.77, 127.13, 127.09, 126.86, 126.77, 126.74, 121.98, 121.85 (14d, C(arom)); 117.54, 117.48 (2s, CN); 113.05 (d, C(arom)); 86.19, 86.11, 85.86, 85.78 (4d, C(4″)); 86.13, 86.08 (2s, C(Ph)$_3$DMT); 79.92, 79.85 (2d, C(1″)); 76.33, 76.09, 75.86, 75.64 (4d, C(3″)); 64.13, 64.08 (2t, C(5″)); 58.42, 58.39, 58.17, 58.14 (4t, CH_2–OP); 55.21, 55.20 (2q, CH_3O-DMT); 43.39, 43.33 (2t, C(2″)); 43.28, 43.23, 43.11, 43.06 (4d, CH—*i*Pr); 24.67, 24.58, 24.51, 24.42 (4q, CH_3-*i*Pr); 20.42, 20.33, 20.25, 20.15 (4t, CH_2–CN). HR-ESI$^+$-MS: *m*/*z* 818.3594 ([M+H]$^+$; $C_{47}H_{52}N_3O_8PNa$ calcd 818.3570). IR (KBr): υ_{max} 2967m, 2932m, 2253w, 1737w, 1609m, 1584w, 1533s, 1510s, 1464m, 1446w, 1397w, 1351s, 1302w, 1252s, 1201w, 1179s, 1156w, 1076m, 1035s, 978m, 878w, 830m, 806w, 791w, 727m, 704w, 640w, 585w, 522w.

4.3.7. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-3″-*O*-(2-cyanoethyl-*N*,*N*′-diisopropylaminophosphino)-β-D-ribofuranosyl]-3-Fmoc-aminobiphenyl (8h). *Method B*. Colorless foam (537 mg, 0.66 mmol, 89%). R_f 0.3 (hexane/EtOAc 7:3 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.77 (d, 2H, J = 7.4, H(arom)); 7.65–7.18 (m, 23H, H(arom)); 6.85–6.73 (m, 5H, H(arom), –NH–); 5.21 (ddd, 1H, J_1 = 2.1, J_2 = 4.9, J_3 = 10.4, H-C(1″)); 4.58–4.50 (m, 3H, H-C(3″), H-Fmoc); 4.31–4.22 (m, 2H, H-C(4″), H-Fmoc); 3.90–3.51 (m, 4H, CH_2OP, 2× CH—*i*Pr); 3.77, 3.76 (2s, 6H, 2× CH_3O-DMT); 3.39–3.22 (m, 2H, H-C(5″)); 2.62 (t, 1H, J = 6.4, CH_2CN); 2.50–2.31 (m, 2H, H-C(2″), CH_2CN); 2.14–2.01 (m, 1H, H-C(2″)); 1.28–1.04 (m, 12H, 4× CH_3-*i*Pr). ^{31}P NMR (162 MHz, $CDCl_3$): δ 148.23, 148.02. ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.46, 153.40, 144.89, 143.74, 141.98, 141.95, 141.38, 141.15, 141.12, 139.93, 139.87, 138.15, 136.17, 136.14, 136.12 (15s, C(arom)); 130.17, 129.47, 128.35, 128.30, 127.88, 127.14, 127.10, 126.77, 126.74, 126.54, 124.96, 122.40, 120.06, 117.53 (14d, C(arom));, 117.48 (s, CN); 113.11 (d, C(arom)); 86.14 (s, C(Ph)$_3$DMT); 86.11, 86.04, 85.79, 85.71 (4d, C(4′)); 80.09, 80.02 (2d, C(1″)); 76.39, 76.15, 75.96, 75.73 (4d,

C(3″)); 66.88, 64.23, 64.17 (3t, C(5″), C(Fmoc)); 58.47, 58.22 (2t, CH_2OP); 55.23, 5.22 (2q, CH_3O-DMT); 47.18 (d, C(Fmoc)); 43.34 (t, C(2″)), 43.30, 43.25, 43.18, 43.13 (4d, CH—*i*Pr); 24.68, 24.58, 24.53, 24.43 (4q, CH_3-*i*Pr); 20.42, 20.33, 20.26, 20.17 (4t, CH_2–CN). HR-ESI$^+$-MS: *m*/*z* 1032.4348 ([M+Na]$^+$; $C_{62}H_{64}N_3O_8P$-Na calcd 1032.4328). IR (KBr): υ_{max} 3036w, 2965m, 2930m, 2836w, 2252w, 1735s, 1608s, 1543m, 1509s, 1463m, 1446m, 1397w, 1364w, 1317m, 1301m, 1250s, 1209s, 1179s, 1155m, 1075s, 1036s, 977m, 889w, 830m, 790w, 758m, 740s, 701m, 641w, 621w, 585w, 543w, 524w, 428w.

4.3.8. 4′-[2″-Deoxy-5″-*O*-(4,4′-dimethoxytriphenylmethyl)-3″-*O*-(2-cyanoethyl-*N*,*N*′-diisopropylaminophosphino)-β-D-ribofuranosyl]-4-Fmoc-aminobiphenyl (8g). *Method A*. (70 mg, 0.07 mmol, 58%) as a colorless foam. R_f 0.3 (hexane/EtOAc 7:3 + 1% Et_3N). ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.78 (d, 2H, J = 7.4, H(arom)); 7.63 (d, 2H, J = 7.4, H(arom)); 7.56–7.16 (m, 21H, H(arom)); 6.85–6.77 (m, 4H, H(arom)); 6.72 (s, 1H, –HN–); 5.21 (ddd, 1H, J_1 = 2.1, J_2 = 5.0, J_3 = 10.5, H-C(1″)); 4.59–4.50 (m, 3H, H-C(3″), H-Fmoc); 4.32–4.22 (m, 2H, H-C(4″), H-Fmoc); 3.90–3.51 (m, 4H, CH_2OP, 2× CH—*i*Pr); 3.78, 3.77 (2s, 6H, 2× CH_3O-DMT); 3.39–3.22 (m, 2H, H-C(5″)); 2.62 (t, 1H, J = 6.6, CH_2CN); 2.49–2.31 (m, 2H, H-C(2″), CH_2CN); 2.13–2.00 (m, 1H, H-C(2″)); 1.29–1.06 (m, 12H, 4× CH_3-*i*Pr). ^{31}P NMR (162 MHz, $CDCl_3$): δ 148.23, 148.01. ^{13}C NMR (75 MHz, $CDCl_3$): δ 158.46, 153.37, 144.94, 143.76, 141.40, 140.62, 140.59, 139.77, 139.71, 136.98, 136.26, 136.17, 136.15, 136.13 (14s, C(arom)); 130.19, 130.16, 128.34, 128.30, 127.81, 127.63, 127.15, 126.74, 126.59, 124.95, 120.07, 119.14 (12d, C(arom)); 117.52, 117.48 (2s, CN); 113.10 (d, C(arom)); 86.14, 86.78 (2s, $C(Ph)_3$DMT); 86.11, 85.71 (2d, C(4′)); 80.13, 80.07 (2d, C(1″)); 77.23, 76.19, 75.99, 75.77 (4d, C(3″)); 66.90, 64.25, 64.20 (3t, C(5″), C(Fmoc)); 58.47, 58.24 (2t, CH_2OP); 55.22 (q, CH_3O-DMT); 47.18 (d, C(Fmoc)); 43.19 (t, C(2″)), 43.18, 43.13 (2d, CH—*i*Pr); 24.68, 24.59, 24.52, 24.43 (4q, CH_3-*i*Pr); 20.43, 20.33, 20.26, 20.17 (4t, CH_2–CN). HR-ESI$^+$-MS: *m*/*z* 1032.4283 ([M+Na]$^+$; $C_{62}H_{64}N_3O_8P$-Na calcd 1032.4328). IR (KBr): υ_{max} 3035w, 2965m, 2930m, 2836w, 2252w, 1734m, 1608m, 1534m, 1509s, 1463w, 1448m, 1397w, 1364w, 1317m, 1301m, 1251s, 1214s, 1179s, 1156m, 1074s, 1054s, 1033s, 1003m, 977m, 902w, 824m, 791w, 758m, 740m, 703m, 620w, 584w, 524w, 427w.

4.3.9. 3,5-Dinitrophenyl-pinacolboronate. A solution of 1-Iodo-3,5-dinitrobenzene (2.94 g, 10.0 mmol), pinacolborane (2.2 ml, 15.0 mmol), Et_3N (4.3 ml, 30.0 mmol), and $PdCl_2$(dppf) (245 mg, 3 mol%) in dry dioxane (40 ml) was stirred at 85 °C over 16 h. After cooling to room temperature, the solution was poured into 2 M NaOH solution (400 ml) and washed with CH_2Cl_2 (3 × 100 ml). The combined organic phases were extracted with 2 M NaOH solution (2 × 100 ml). The combined basic extracts were cooled to 0 °C and adjusted to pH 3 with 85% H_3PO_4. The acidic solution was extracted with *t*-BuOMe (4 × 100 ml). The combined organic phases were washed with brine (100 ml), dried over $MgSO_4$, filtered, and concentrated in vacuo. Hexane (200 ml) was added to the residue and the mixture was heated to the reflux for 30 min. The mixture was slowly cooled to −78 °C and the precipitate was filtered off, washed with cold hexane, and dried in vacuo to yield the desired compound (1.58 g, 5.4 mmol, 54%) as a brownish powder. ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.11 (t, 1H, J = 2.26, H-4); 8.93 (d, 2H, J = 2.26, H-2, H-5); 1.40 (s, 12H, 4× CH_3). ^{11}B-MMR (128 MHz, $CDCl_3$): δ 32.92 (s). ^{13}C NMR (101 MHz, $CDCl_3$): δ 148.17 (s, C(arom)); 134.41, 120.99 (2d, C(arom)); 85.48 (s, 2× $C(CH_3)_2$); 24.85 (q, 4× CH_3). HR-EI-MS: *m*/*z* 294.1035 (M$^+$; $C_{12}H_{15}BN_2O_6$ calcd 294.1023). IR (neat): υ_{max} 3108w, 2984w, 1627w, 1586w, 1542m, 1468w, 1372w, 1336s, 1265w, 1209w, 1168w, 1136m, 1074w, 968w, 918w, 846m, 812w, 728m, 687s, 661w, 640w.

4.3.10. Oligonucleotide synthesis. Oligonucleotide synthesis was performed on an Expedite 8909 (Applied Biosystems) or a Gene Assembler Plus (Pharmacia) DNA synthesizer on a 1.0 or 1.3 μmol scale using standard phosphoramidite chemistry and phosphoramidites of the natural nucleosides (Glen Research) as well as phosphoramidites **8a**, **c**, **e**, **f**. 5-(ethylthio)-1*H*-tetrazole (0.25 M in CH_3CN) were used as the coupling reagent and 3% dichloroacetic acid in dichloroethane was used for the detritylation step. After synthesis, the oligonucleotides were detached and deprotected in concd. ammonia (55 °C, 16 h). Crude oligonucleotides were purified by RP-HPLC on an Äkta P-900 (Pharmacia) with a Source 15RPC ST 4.6/100 column (Pharmacia). A gradient of the following two solutions was used for elution: A: 0.1 M triethylammonium acetate (TEAA) in H_2O; B: 0.1 M TEAA in 80% AcCN. The integrity of the oligonucleotides was confirmed with ESI$^-$-MS spectroscopy.

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