Supporting Files

Attenuation of decabromodiphenyl ether (BDE209) using Ag/Fe^0 complexed with citrate in various environmental and toxicity assessment by evaluating ryegrass

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Tab. S1 Orthogonal Experiment on Degradation of BDE209 by Ag/Fe^0-NaCA/CA System

Initial concentration of BDE209 / Dosage of Ag/Fe^0	5 mg/Kg soil	10 mg/Kg soil	15 mg/Kg soil
10 g/Kg soil	B5-10	B10-10	B15-10
20 g/Kg soil	B5-20	B10-20	B15-20
30 g/Kg soil	B5-30	B10-30	B15-30

Tab. S2 Significance test of Chlorophyll

BDE209 Concentration (mg/Kg soil)	Ag/mZVI (g/Kg soil)	Mean	SD	Mean Deviation	p	95% Confidence interval	
						lower limit	upper limit
Black control		1.7803	0.03001				
5	10	0.7723	0.0165	1.008**	<0.001	0.9257	1.0903
	20	1.1007	0.05501	0.680**	<0.001	0.5974	0.7619
	30	1.2703	0.02967	0.510**	<0.001	0.4277	0.5923
10	10	2.2423	0.06586	-0.462**	<0.001	-0.5443	-0.3797
	20	1.3723	0.04727	0.408**	<0.001	0.3257	0.4903
	30	1.1533	0.06882	0.627**	<0.001	0.5447	0.7093
15	10	2.3507	0.07558	-0.570**	<0.001	-0.6526	-0.4881
	20	1.5527	0.03894	0.228**	<0.001	0.1454	0.3099
	30	1.4743	0.05835	0.306**	<0.001	0.2237	0.3883

(* indicates significant difference $p < 0.05$, **indicates significant difference $p<0.001$)

Tab. S3 Significance test of Chlorophyll (5ppm BDE209)

Ag/mZVI (g/Kg soil)	Mean	SD	Mean Deviation	p	95% Confidence interval lower limit	95% Confidence interval upper limit
0	0.9817	0.0319				
10	0.7723	0.0165	0.20933**	<0.001	0.1271	0.2916
20	1.1007	0.05501	-0.11900*	0.006	-0.2013	-0.0367
30	1.2703	0.02967	-0.28867**	<0.001	-0.3709	-0.2064

(* indicates significant difference $p < 0.05$, **indicates significant difference $p<0.001$)

Tab. S4 Significance test of Chlorophyll (10ppm BDE209)

Ag/mZVI (g/Kg soil)	Mean	SD	Mean Deviation	p	95% Confidence interval lower limit	95% Confidence interval upper limit
0	0.8637	0.02548				
10	2.2423	0.06586	-1.37867**	<0.001	-1.4609	-1.2964
20	1.3723	0.04727	-0.50867**	<0.001	-0.5909	-0.4264
30	1.1533	0.06882	-0.28967**	<0.001	-0.3719	-0.2074

(* indicates significant difference $p < 0.05$, **indicates significant difference $p<0.001$)

Tab. S5 Significance test of Chlorophyll (15ppm BDE209)

Ag/mZVI (g/Kg soil)	Mean	SD	Mean Deviation	p	95% Confidence interval lower limit	95% Confidence interval upper limit
0	1.0310	0.05059				
10	2.3507	0.07558	-1.31967*	<0.001	-1.4019	-1.2374
20	1.5527	0.03894	-0.52167**	<0.001	-0.6039	-0.4394
30	1.4743	0.05835	-0.44333**	<0.001	-0.5256	-0.3611

(* indicates significant difference $p < 0.05$, **indicates significant difference $p<0.001$)

Tab. S6 Significance test of MDA

Ag/Mzvi (g/Kg soil)	Mean	SD	Mean Deviation	p	95% Confidence interval	
					lower limit	upper limit
Black control	9.0537	0.06760				
0	15.1523	0.19956	-6.09867**	<0.001	-6.3150	-5.8824
10	15.1533	0.13969	-6.09967**	<0.001	-6.3160	-5.8834
20	17.1750	0.09246	-8.12133**	<0.001	-8.3376	-7.9050
30	9.5413	0.19914	-0.48767**	<0.001	-0.7040	-0.2714
0	15.6987	0.18249	-6.645**	<0.001	-6.8613	-6.4287
10	17.7570	0.08793	-8.70333**	<0.001	-8.9196	-8.487
20	11.8143	0.13979	-2.76067**	<0.001	-2.9770	-2.5444
30	9.1987	0.10843	-0.145	0.180	-0.3613	0.0713
0	16.4860	0.08654	-7.43233**	<0.001	-7.6486	-7.2160
10	11.0443	0.06992	-1.99067**	<0.001	-2.2070	-1.7744
20	13.4580	0.09866	-4.40433**	<0.001	-4.6206	-4.1880
30	9.4603	0.09692	-0.40667**	0.001	-0.6230	-0.1904

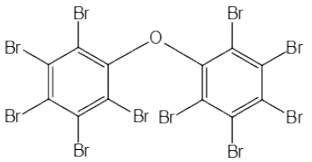
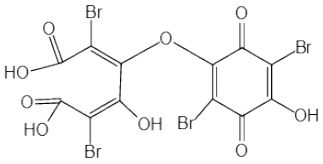
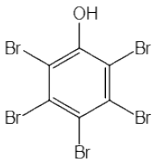
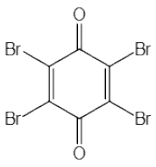
(* indicates significant difference $p < 0.05$, **indicates significant difference $p<0.001$)

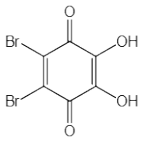
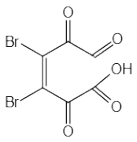
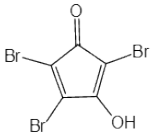
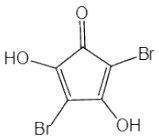
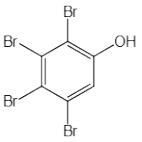
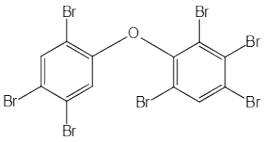
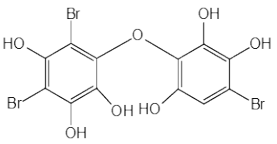
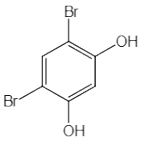
BDE209 Concentration (mg/Kg soil)
5
10
15

Tab. S7 Elemental atomic composition of newly prepared Ag/Fe^0 materials and materials after Ag/Fe^0-CA reaction

element	Newly prepared (%)	After reaction (%)
oxygen（O）	45.51	59.26
iron（Fe）	54.37	40.34
silver（Ag）	0.12	0.40
total	100	100

Tab. S8 LC-MS detection of BDE209 degradation process product details

Number	Molecular formula	keep time（min）	m/z (+/- Ion mode)	Structural formula
I	$C_{12}Br_{10}O$	9.39	961.22 (+)	
II	$C_{12}H_4Br_4O_9$	7.28	616.14 (-)	
III	C_6HBr_5O	9.26	486.58 (-)	
IV	$C_6Br_4O_2$	12.18	423.33 (-)	

V	$C_6H_2Br_2O_4$	0.64	300.16 (+)	
VI	$C_6HBr_2O_5$	10.02	313.27 (+)	
VII	$C_5HBr_3O_2$	10.33	333.23 (-)	
VIII	$C_5H_2Br_2O_3$	4.46	270.97 (+)	
IX	$C_6H_2Br_4O$	9.61	408.67 (-)	
X	$C_{12}H_3Br_7O$	7.19	728.05 (-)	
XI	$C_{12}H_7Br_3O_7$	6.49	509.07 (-)	
XII	$C_6H_4Br_2O_2$	8.07	266.99 (-)	

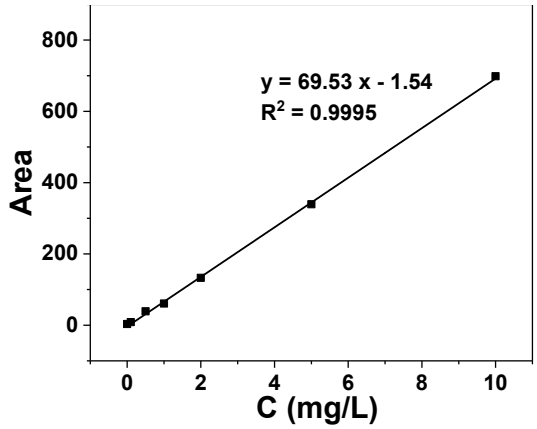


Fig. S1 The standard curve of BDE209 detection by HPLC

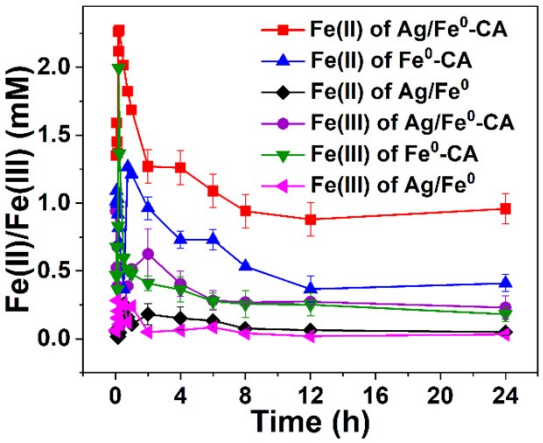


Fig. S2 Variation of soluble iron content in different systems

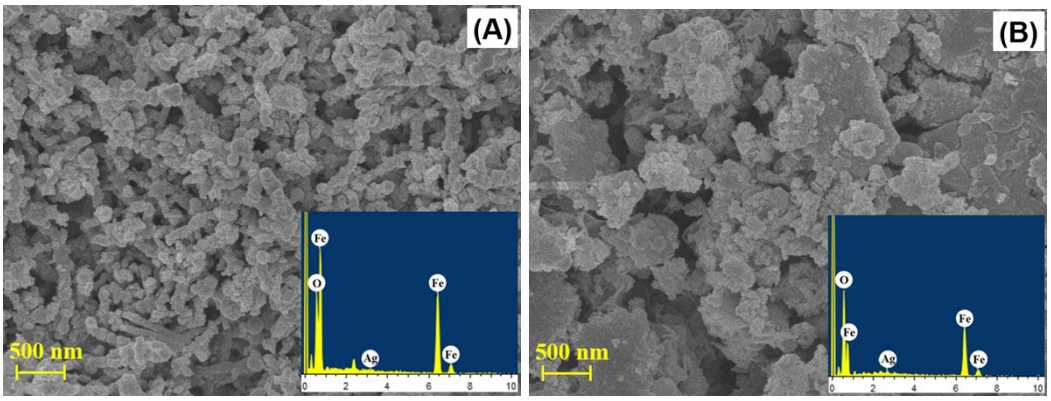


Fig. S3 (A) SEM image of newly prepared Ag/Fe^0 material; (B) SEM image of the material after Ag/Fe^0-CA reaction. The inset is corresponding to EDX

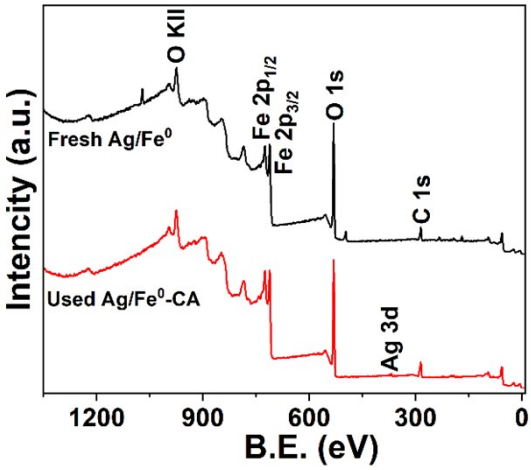


Fig. S4 XPS spectrum of the material before and after the reaction of full range

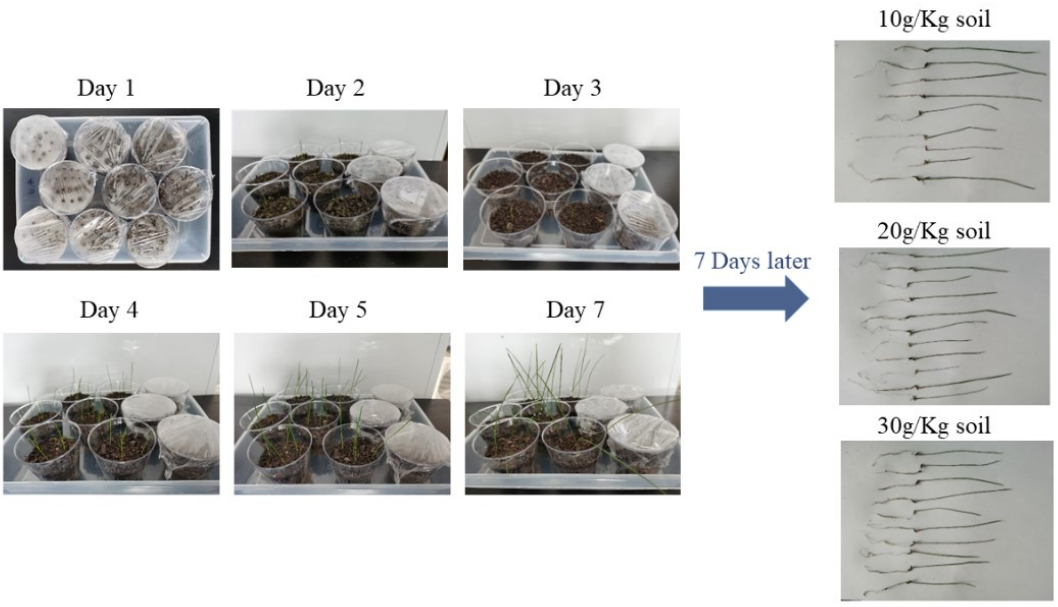


Fig. S5 Growth status of ryegrass remediated soil by Ag/Fe^0-NaCA/CA during 7-day planting

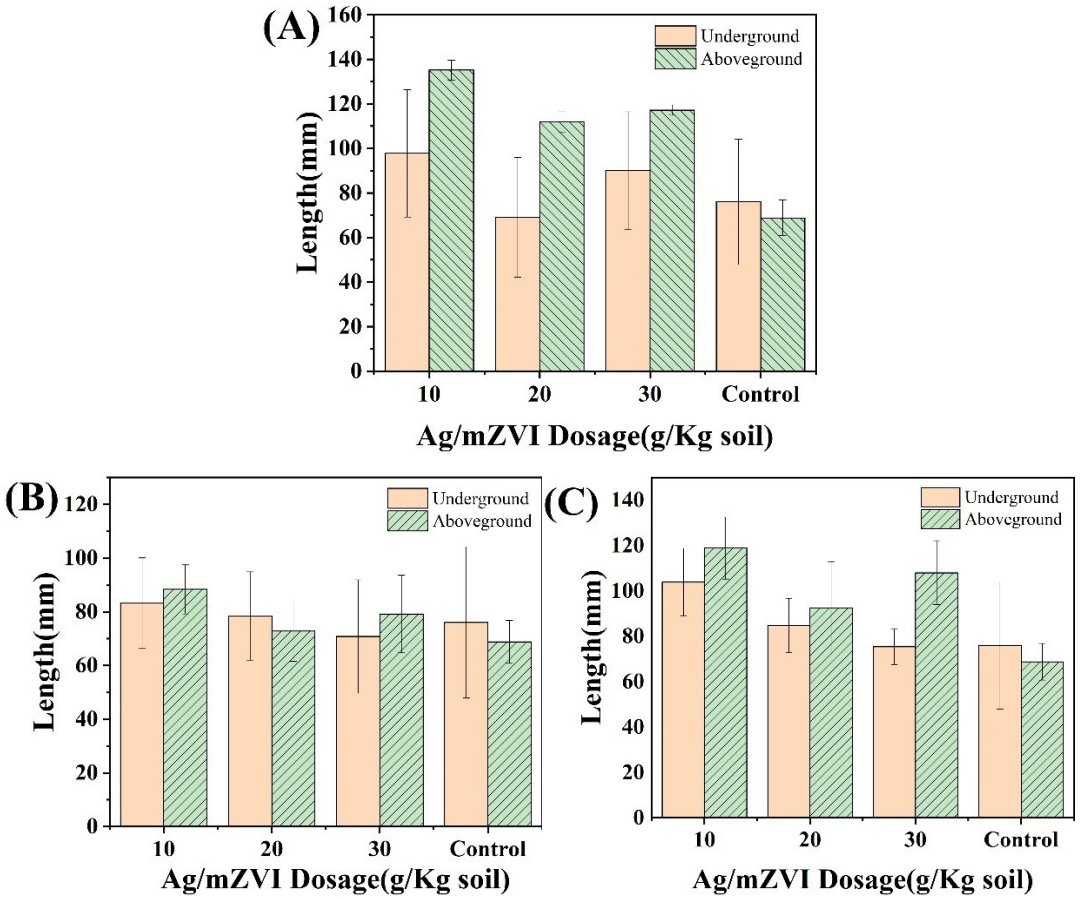
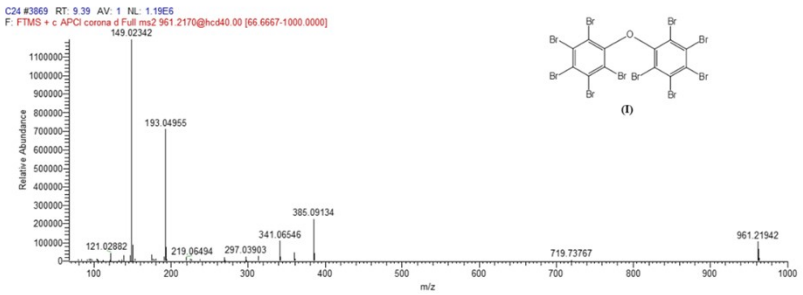
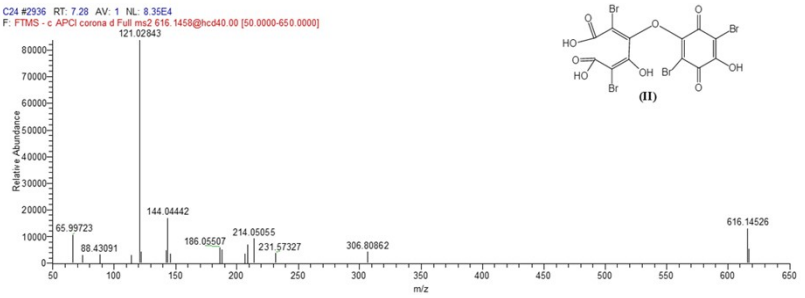
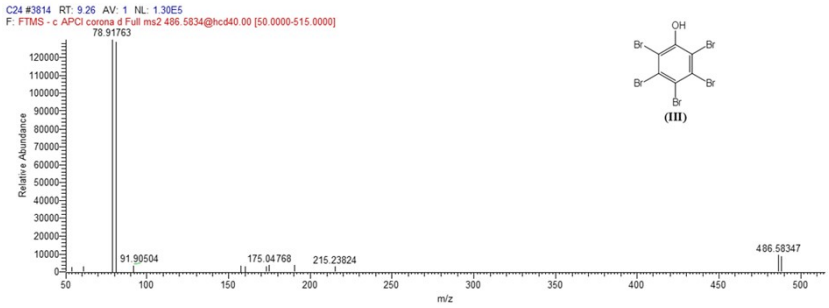
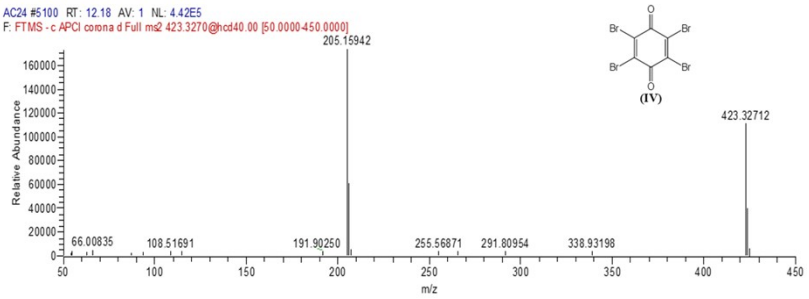


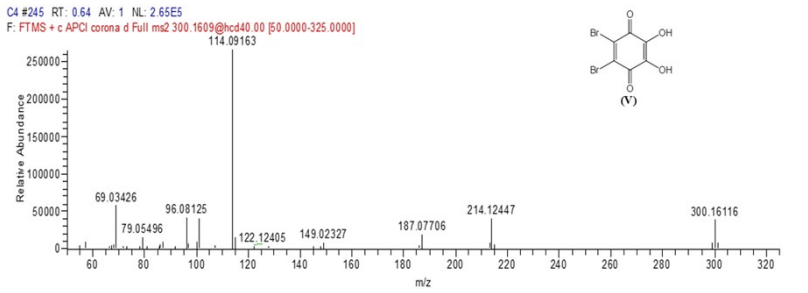
Fig. S6 Plant length of ryegrass in (A) 10 mg/Kg, (B) 20 mg/Kg, (C) 15 mg/Kg Ag/Fe^0-NaCA/CA system

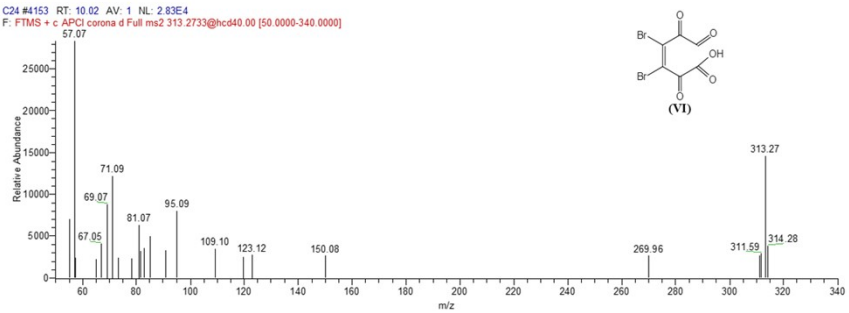

C24 #3869 RT: 9.39 AV: 1 NL: 1.19E6
F: FTMS + c APCI corona d Full ms2 961.2170@hcd40.00 [66.6667-1000.0000]
149.02342
193.04955
385.09134
341.06546
961.21942
121.02882
219.06494
297.03903
719.73767
Relative Abundance
m/z
(I)

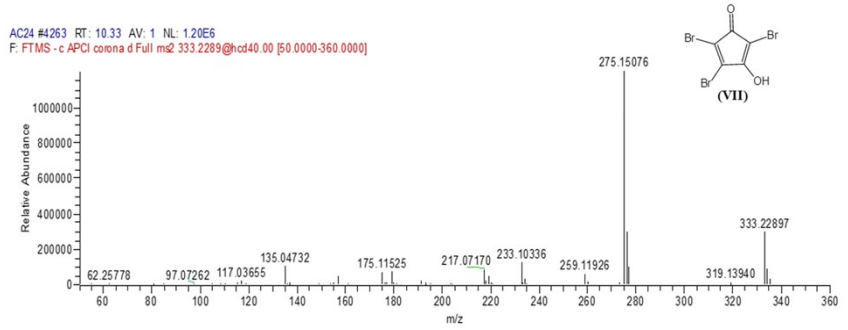

C24 #2936 RT: 7.28 AV: 1 NL: 8.35E4
F: FTMS - c APCI corona d Full ms2 616.1458@hcd40.00 [50.0000-650.0000]
121.02843
144.04442
616.14526
65.99723
88.43091
186.05507
214.05055
231.57327
306.80862
Relative Abundance
m/z
(II)

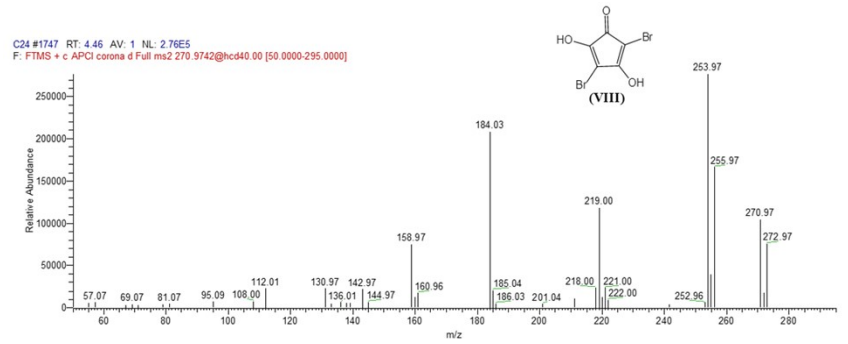

C24 #3814 RT: 9.26 AV: 1 NL: 1.30E5
F: FTMS - c APCI corona d Full ms2 486.5834@hcd40.00 [50.0000-515.0000]
78.91763
91.99504
175.04768
215.23824
486.58347
Relative Abundance
m/z
(III)

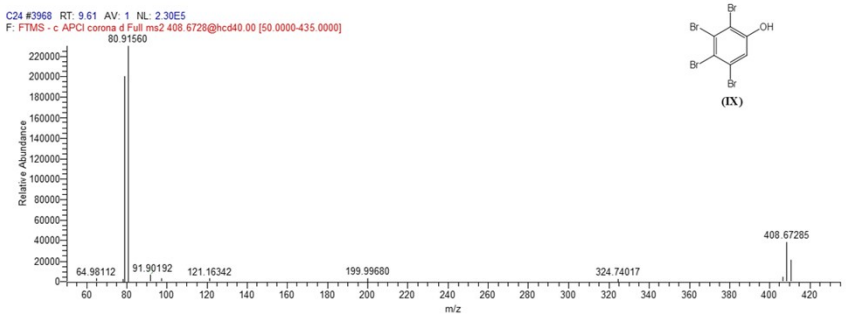

AC24 #5100 RT: 12.18 AV: 1 NL: 4.42E5
F: FTMS - c APCI corona d Full ms2 423.3270@hcd40.00 [50.0000-450.0000]
205.15942
423.32712
66.00835
108.51691
191.90250
255.56871
291.80954
338.93198
Relative Abundance
m/z
(IV)

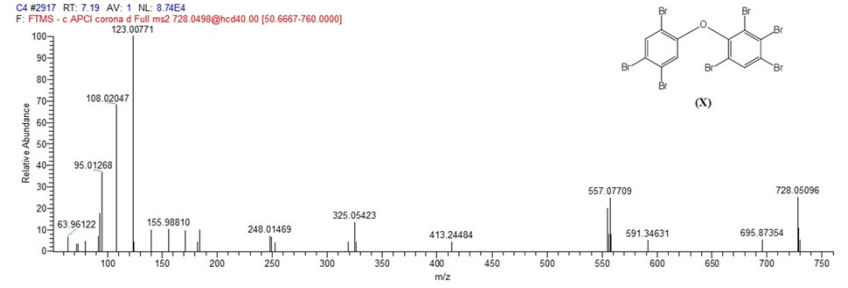

C4 #245 RT: 0.64 AV: 1 NL: 2.65E5
F: FTMS + c APCI corona d Full ms2 300.1609@hcd40.00 [50.0000-325.0000]
114.09163
69.03426
96.08125
79.05496
122.12405
149.02327
187.07706
214.12447
300.16116
Relative Abundance
m/z
(V)


C24 #4153 RT: 10.02 AV: 1 NL: 2.83E4
F: FTMS + c APCI corona d Full ms2 313.2733@hcd40.00 [50.0000-340.0000]
Relative Abundance
m/z
57.07
71.09
69.07
95.09
81.07
67.05
109.10
123.12
150.08
269.96
311.59
313.27
314.28
(VI)


AC24 #4263 RT: 10.33 AV: 1 NL: 1.20E6
F: FTMS - c APCI corona d Full ms2 333.2289@hcd40.00 [50.0000-360.0000]
Relative Abundance
m/z
275.15076
333.22897
135.04732
175.11525
217.07170
233.10336
259.11926
319.13940
62.25778
97.07262
117.03655
(VII)


C24 #1747 RT: 4.46 AV: 1 NL: 2.76E5
F: FTMS + c APCI corona d Full ms2 270.9742@hcd40.00 [50.0000-295.0000]
Relative Abundance
m/z
253.97
184.03
255.97
219.00
270.97
272.97
158.97
112.01
130.97
142.97
160.96
185.04
218.00
221.00
222.00
252.96
57.07
69.07
81.07
95.09
108.00
136.01
144.97
186.03
201.04
(VIII)


C24 #3968 RT: 9.61 AV: 1 NL: 2.30E5
F: FTMS - c APCI corona d Full ms2 408.6728@hcd40.00 [50.0000-435.0000]
Relative Abundance
m/z
80.91560
408.67285
64.98112
91.90192
121.16342
199.99680
324.74017
(IX)


C4 #2917 RT: 7.19 AV: 1 NL: 8.74E4
F: FTMS - c APCI corona d Full ms2 728.0498@hcd40.00 [50.6667-760.0000]
Relative Abundance
m/z
123.00771
108.02047
95.01268
63.96122
155.98810
248.01469
325.05423
413.24484
557.07709
591.34631
695.87354
728.05096
(X)

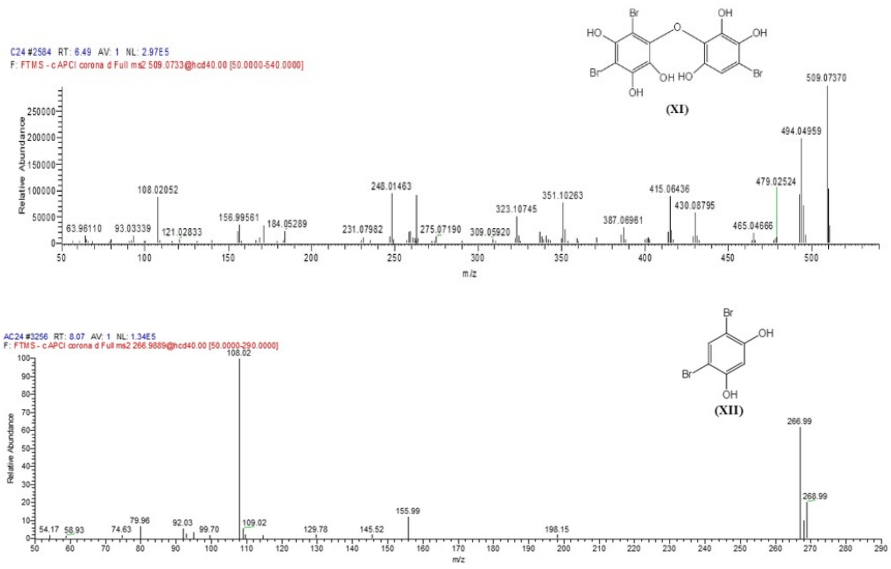


Fig. S7 LC-MS detection of the mass spectrum of the degradation products of BDE209