

## Supplementary information

### Field dissipation and plant uptake of benzotriazole ultraviolet stabilizers in biosolid-amended soils

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**Fig. S1** Field dissipation of UV-326, UV-327, UV-328, UV-329 and UV-P in the biosolid-amended soils of OT2 within one year (October 2010 to October 2011). OT2: 10 t/ha of biosolid applied in the plots every year since first application in October 2006.

**Fig. S2** Field dissipation of UV-326, UV-327, UV-328, UV-329 and UV-P in the biosolid-amended soils of OT3 within one year (October 2010 to October 2011). OT3: 20 t/ha of biosolid applied in the plots every year since first application in October 2006.

**Fig. S3** Field dissipation of UV-326, UV-327, UV-328, UV-329 and UV-P in the biosolid-amended soils of OT4 within one year (October 2010 to October 2011). OT4: 40 t/ha of biosolid applied in the plots every year since first application in October 2006.

**Fig. S4** Field dissipation of UV-326, UV-327, UV-328, UV-329 and UV-P in the biosolid-amended soils of NT3 within one year (October 2010 to October 2011). NT3: 20 t/ha of biosolid applied once in October 2010.

**Fig. S5** Field dissipation of UV-326, UV-327, UV-328, UV-329 and UV-P in the biosolid-amended soils of NT4 within one year (October 2010 to October 2011). NT4: 40 t/ha of biosolid applied once in October 2010.

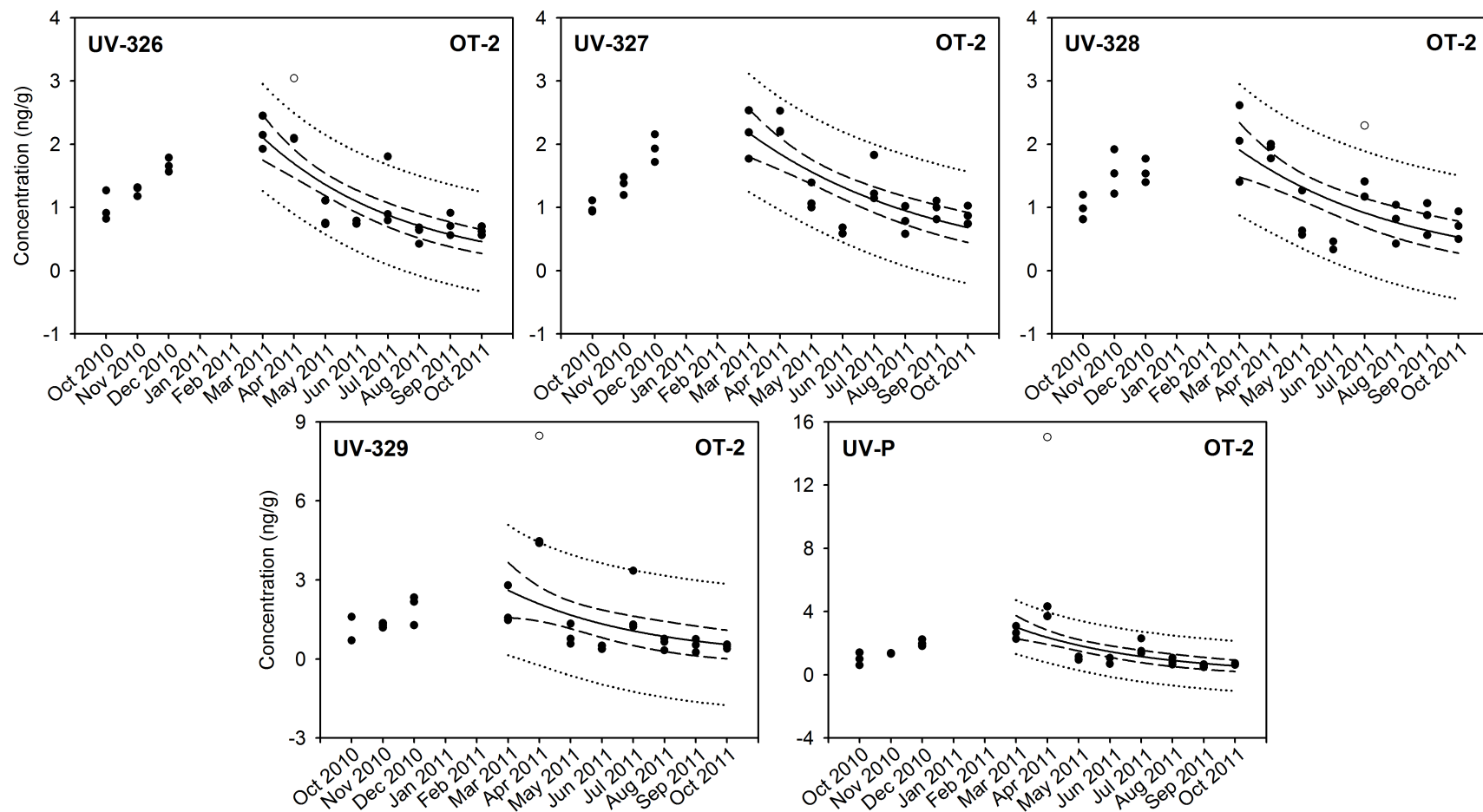
### Table Captions:

**Table S1** Characteristic ions and retention times for target compounds in GC-MS.

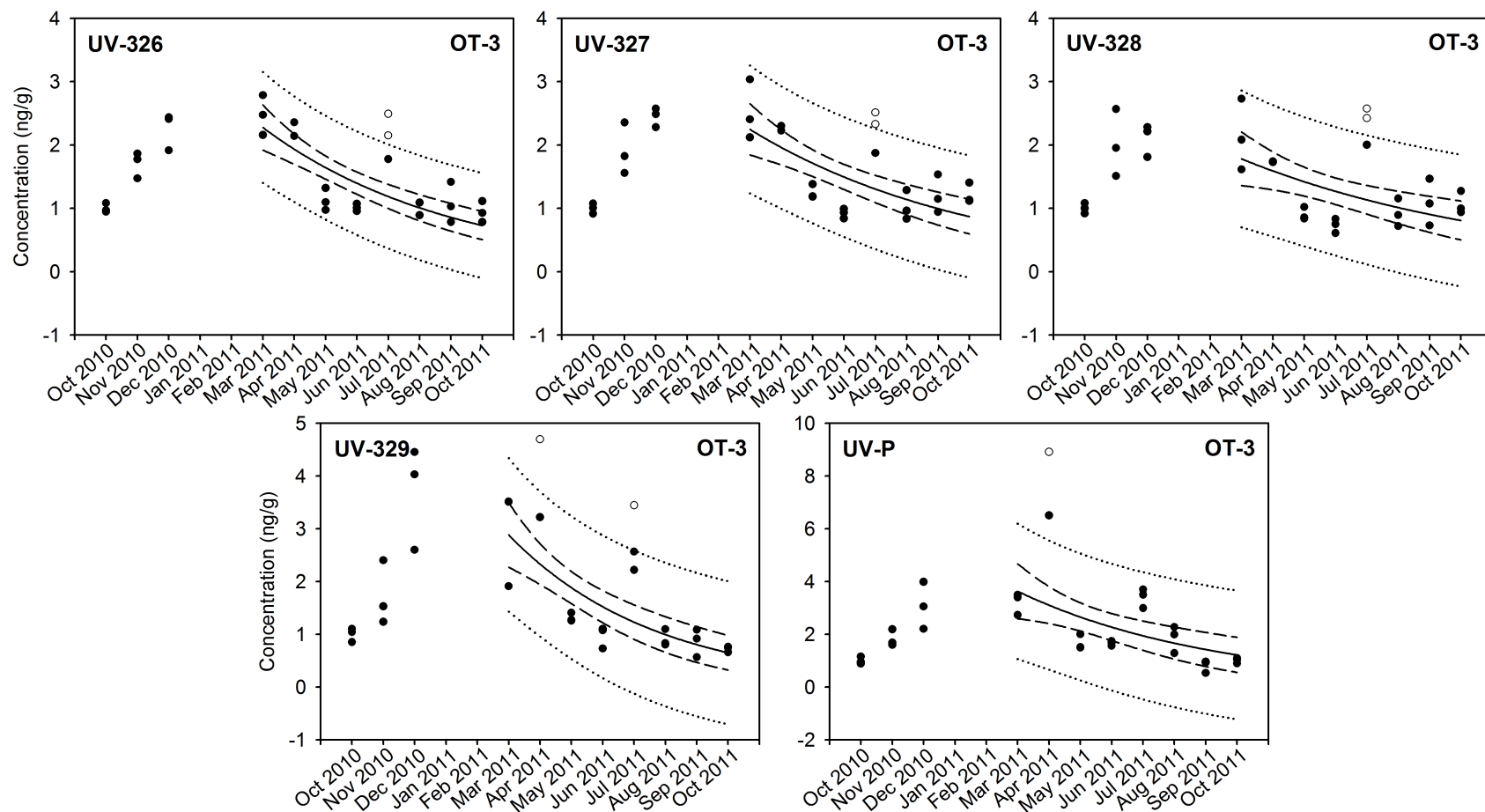
**Table S2** Recoveries (%) and method precision (RSD % for n = 3), limits of detection (LOD) and quantitation (LOQ) for target compounds.

**Table S3** Concentrations of BUVSs in the biosolid-amended soils of the old group (OT1, OT2, OT3 and OT4) for one year monitoring.

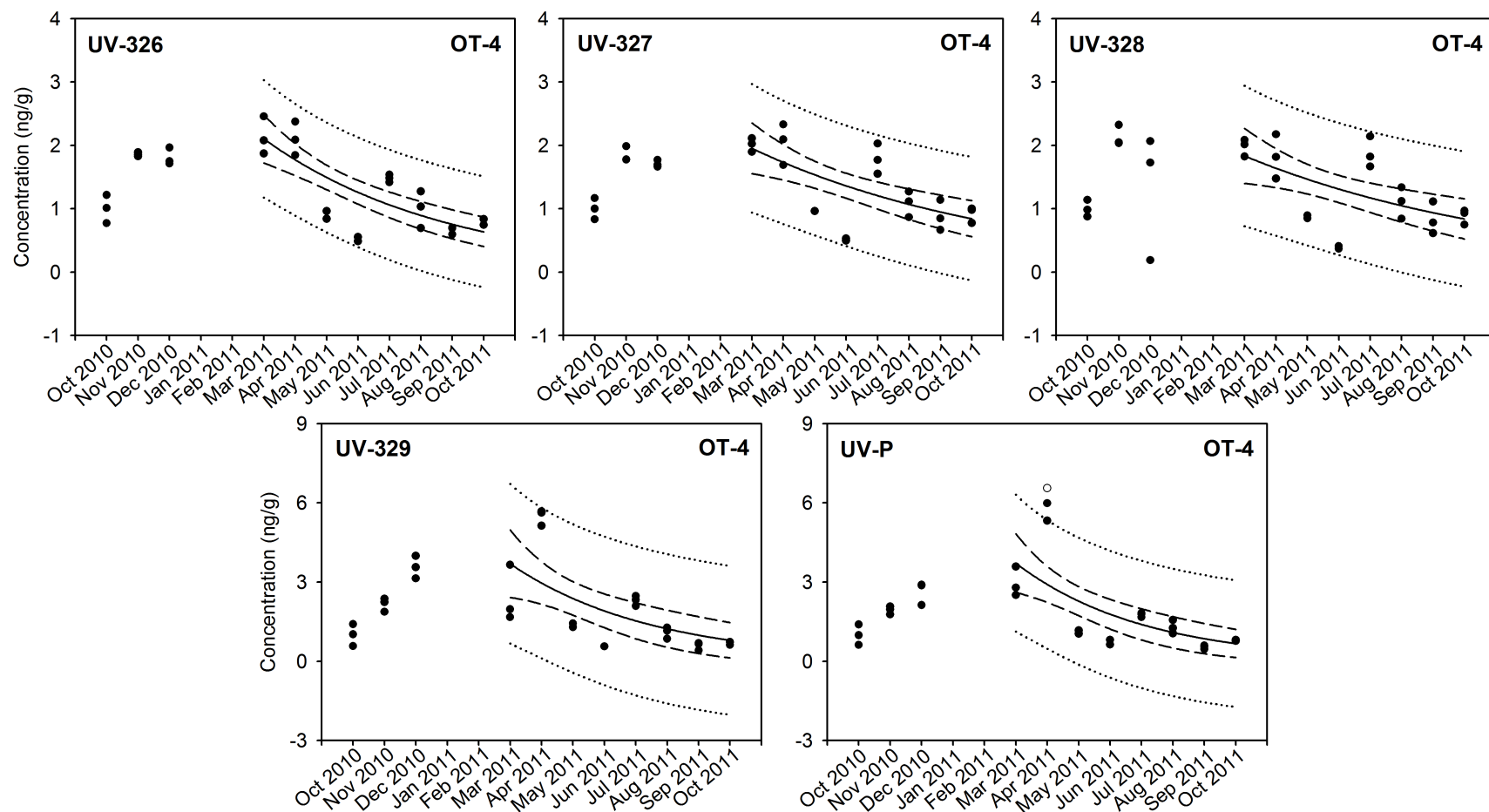
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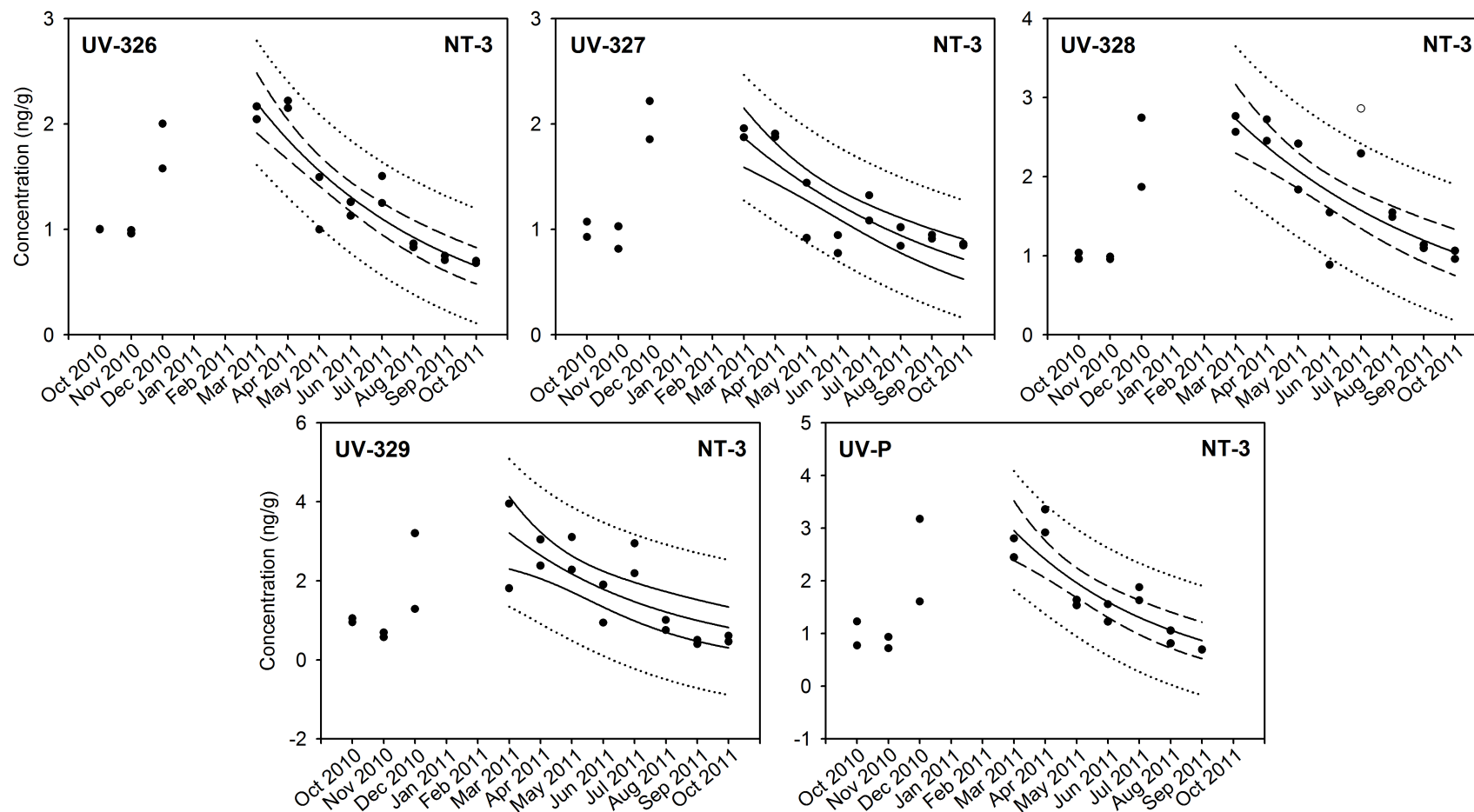
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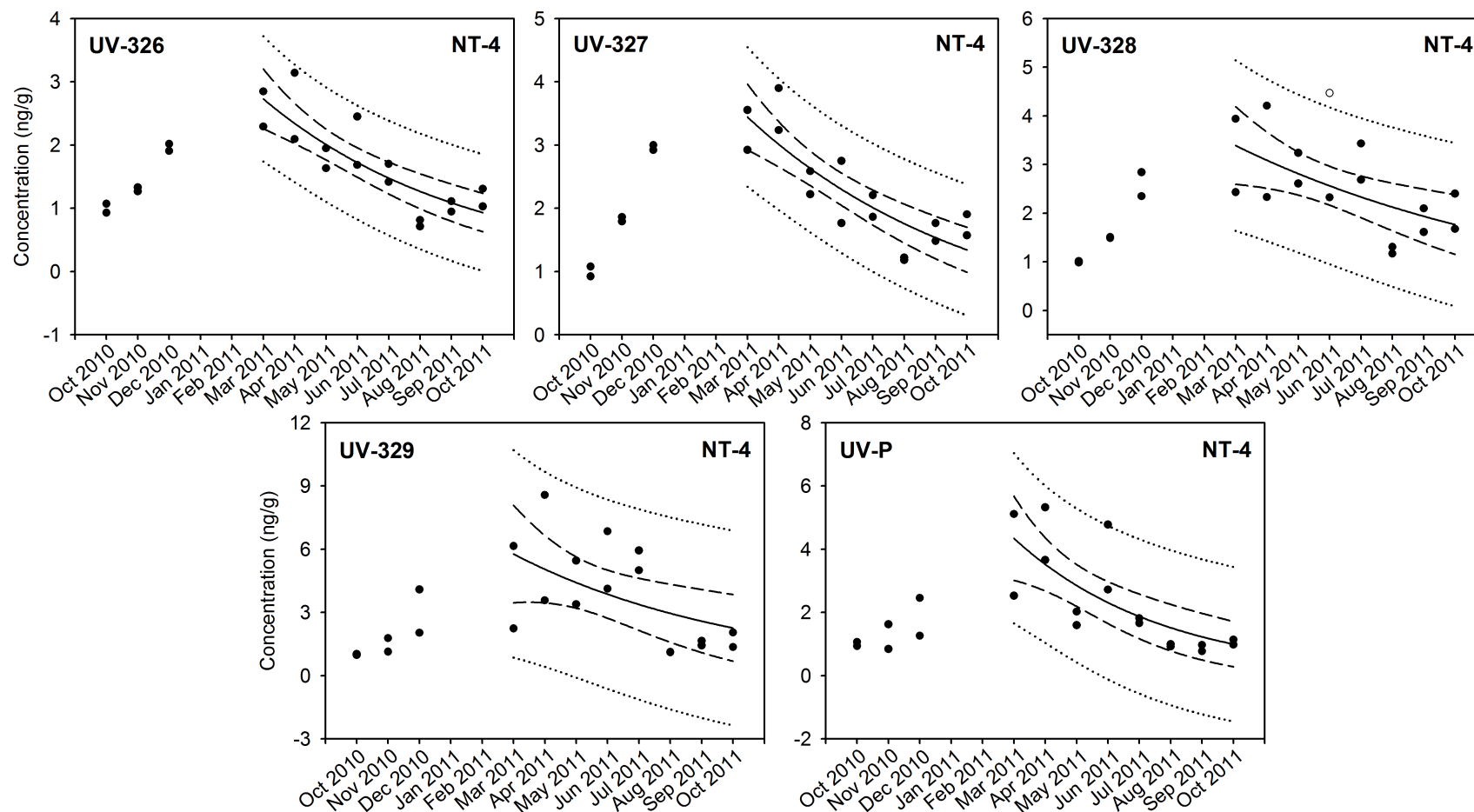
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**Fig. S4** Field dissipation of UV-326, UV-327, UV-328, UV-329 and UV-P in the biosolid-amended soils of NT3 within one year (October 2010 to October 2011). NT3: 20 t/ha of biosolid applied once in October 2010.



**Fig. S5** Field dissipation of UV-326, UV-327, UV-328, UV-329 and UV-P in the biosolid-amended soils of NT4 within one year (October 2010 to October 2011). NT4: 40 t/ha of biosolid applied once in October 2010.

**Table S1.** Characteristic ions and retention times for target compounds in GC-MS.

Compound	M.W.	R.T.	Ions <sup>a</sup>		
Chrysene-d12 (IS)	240	12.510	<b>240</b>	236	241
UV-P	225	9.768	<b>225</b>	226	224
Benzyl cinnamate (SS)	238	9.893	<b>131</b>	192	193
UV-326	315	12.958	<b>300</b>	315	302
UV-329	323	13.173	<b>252</b>	253	323
UV-328	351	13.779	<b>322</b>	323	351
UV-327	358	13.837	<b>342</b>	344	343

<sup>a</sup> Quantification ions.



**Table S2** Recoveries (%) and method precision (RSD % for n = 3), limits of detection (LOD) and quantitation (LOQ) for target compounds.

Compound	Soil				Sludge				Plant			
	Recoveries %±RSD	Matrix %±RSD	LODs (ng/g)	LOQs (ng/g)	Recoveries %±RSD	Matrix %±RSD	LODs (ng/g)	LOQs (ng/g)	Recoveries %±RSD	Matrix %±RSD	LODs (ng/g)	LOQs (ng/g)
UV-326	81.7±1.5	105±0.1	0.10	0.32	80.5±4.1	94.7±6.1	2.16	7.18	71.4±0.4	128±4.7	1.68	5.59
UV-327	80.1±0.1	102±0.3	0.08	0.27	78.9±3.3	84.1±4.0	2.77	9.23	97.0±11.3	143±1.4	0.40	1.34
UV-328	80.4±1.0	100±1.0	0.11	0.37	70.9±4.6	86.7±6.0	1.13	3.76	71.4±6.5	143±2.2	0.74	2.46
UV-329	117±1.1	153±0.7	0.09	0.30	112±15.2	105±21.8	1.36	4.52	96.2±5.8	161±3.7	0.44	1.48
UV-P	99.5±4.5	136±5.6	0.37	1.23	112±6.1	136±4.0	3.49	11.6	85.5±12.1	151±5.5	0.73	2.43

**Table S3** Concentrations of BUVSs in the biosolid-amended soils of the old group (OT1, OT2, OT3 and OT4) for one year monitoring.

Compound	Treatment	Oct 2010	Nov 2010	Dec 2010	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	Oct 2011
UV-326	OT1	1.0±0.1 <sup>a</sup>	1.4±0.3	1.9±0.1	2.6±0.03	2.5±0.2	1.1±0.2	1.2±0.1	1.0±0.2	0.7±0.4	0.8±0.1	0.9±0.2 c <sup>b</sup>
	OT2	1.4±0.3	1.8±0.1	2.4±0.2	3.1±0.4	3.4±0.8	1.2±0.3	1.1±0.05	1.7±0.8	0.8±0.2	1.0±0.3	0.9±0.1 c
	OT3	1.6±0.1	2.7±0.3	3.6±0.5	3.9±0.5	3.6±0.2	1.8±0.3	1.6±0.1	3.4±0.6	1.5±0.2	1.7±0.5	1.5±0.3 b
	OT4	3.0±0.7	5.5±0.1	5.4±0.4	6.3±0.9	6.2±0.8	2.7±0.3	1.5±0.1	4.4±0.2	3.0±0.9	2.0±0.2	2.3±0.2 a
UV-327	OT1	1.1±0.2	1.7±0.3	2.7±0.2	3.1±0.2	3.0±0.3	1.7±0.2	1.2±0.1	1.6±0.2	1.2±0.6	1.3±0.1	1.3±0.1 c
	OT2	1.7±0.2	2.3±0.2	3.3±0.4	3.7±0.7	4.4±0.3	2.0±0.4	1.1±0.1	2.4±0.6	1.4±0.4	1.7±0.3	1.5±0.2 c
	OT3	2.0±0.2	3.9±0.8	4.9±0.3	5.1±0.9	4.6±0.1	2.5±0.2	1.9±0.2	4.5±0.7	2.1±0.5	2.4±0.6	2.5±0.3 b
	OT4	4.2±0.7	7.7±0.5	7.1±0.2	8.3±0.4	8.5±1.3	4.0±0.01	2.1±0.1	7.4±1.0	4.5±0.8	3.7±1.0	3.8±0.5 a
UV-328	OT1	2.3±0.5	4.1±0.7	4.3±0.6	6.1±0.5	4.7±0.6	2.4±0.7	1.6±0.4	3.6±0.7	2.7±2.2	1.7±0.2	2.3±0.5 c
	OT2	4.1±0.8	6.3±1.4	6.4±0.8	8.2±2.5	7.8±0.5	3.3±1.6	1.6±0.4	6.6±2.4	3.1±1.3	3.4±1.0	2.9±0.9 c
	OT3	6.1±0.5	12.4±3.3	12.9±1.6	13.2±3.4	10.7±0.1	5.6±0.6	4.5±0.7	14.3±1.8	5.7±1.4	6.7±2.3	6.6±1.1 b
	OT4	13.3±1.8	28.4±2.2	17.6±13.3	26.2±1.8	24.2±4.6	11.6±0.4	5.2±0.4	24.9±3.2	14.6±3.3	11.1±3.4	11.7±1.6 a
UV-329	OT1	5.9±2.8	10.4±2.1	15.6±6.3	16.8±9.3	15.6±3.6	8.2±4.6	6.4±3.1	10.7±3.0	5.2±3.4	2.6±0.1	4.4±1.9 c
	OT2	11.6±6.0	14.8±1.0	22.4±6.6	22.6±8.6	67.1±27.1	10.3±4.6	5.1±1.0	22.8±14.0	6.7±2.6	5.9±2.9	5.5±0.9 c
	OT3	16.9±2.2	29.0±10.2	62.3±16.3	50.2±15.6	66.7±17.6	22.1±1.4	16.4±3.5	46.2±10.6	15.4±2.7	14.4±4.5	12.2±0.9 b
	OT4	30.3±12.6	65.6±7.8	108±12.9	73.7±32.4	166±9.1	41.4±3.0	17.0±0.1	69.7±5.7	33.1±6.7	17.7±4.6	20.9±1.8 a
UV-P	OT1	2.3±0.7	3.1±0.5	3.9±1.0	3.8±1.9	9.1±4.3	4.0±1.1	3.3±0.6	2.8±0.8	2.7±0.9	1.7±0.1	1.7±0.2 c
	OT2	3.0±1.2	4.1±0.1	6.1±0.7	8.0±1.2	23.2±19.2	3.1±0.3	2.6±0.8	5.2±1.5	2.5±0.6	1.7±0.3	2.1±0.2 c
	OT3	3.4±0.5	6.2±1.1	10.5±3.0	10.9±1.4	26.1±5.8	5.7±1.0	5.6±0.3	11.5±1.2	6.3±1.7	2.7±0.8	3.4±0.4 b
	OT4	6.9±2.6	13.3±1.0	18.0±1.0	20.3±3.8	40.8±4.2	7.6±0.6	4.9±0.9	12.0±0.5	8.8±1.8	3.6±0.5	5.4±0.3 a

<sup>a</sup> Mean (ng/g) ± standard deviation (%) (n = 4, replicate samples at the same time).

<sup>b</sup> Letters (a and b) indicate the significant difference of concentration data by Duncan's multiple range test,  $p < 0.05$ .

**Table S4** Concentrations of BUVSs in the biosolid-amended soils of the new group (NT2, NT3 and NT4) for one year monitoring.

Compound	Treatment	Oct 2010	Nov 2010	Dec 2010	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	Oct 2011
UV-326	NT2	1.0±0.03 <sup>a</sup>	1.0±0.1	1.7±0.004	2.3±0.02	2.3±0.04	1.1±0.1	1.0±0.3	0.7±0.1	0.6±0.1	0.7±0.1	0.7±0.01 b <sup>b</sup>
	NT3	1.2±0.003	1.1±0.03	2.1±0.3	2.4±0.1	2.5±0.1	1.4±0.4	1.4±0.1	1.6±0.2	1.0±0.03	0.8±0.03	0.8±0.02 b
	NT4	1.1±0.1	1.5±0.05	2.2±0.1	2.9±0.4	3.0±0.8	2.0±0.3	2.4±0.6	1.8±0.2	0.9±0.1	1.2±0.1	1.3±0.2 a
UV-327	NT2	0.7±0.0	1.0±0.5	2.4±0.1	2.5±0.1	2.7±0.01	1.5±0.1	1.0±0.02	1.1±0.02	0.9±0.02	1.1±0.1	1.1±0.04 b
	NT3	1.3±0.1	1.2±0.2	2.7±0.3	2.5±0.1	2.5±0.03	1.6±0.5	1.1±0.2	1.6±0.2	1.2±0.2	1.2±0.03	1.1±0.02 ab
	NT4	0.9±0.1	1.6±0.04	2.6±0.05	2.8±0.4	3.1±0.4	2.1±0.2	2.0±0.6	1.8±0.2	1.0±0.02	1.4±0.2	1.5±0.2 a
UV-328	NT2	1.2±0.1	1.6±0.7	2.6±0.2	3.7±0.4	3.2±0.1	1.9±0.6	1.2±0.1	1.9±0.1	1.3±0.2	1.2±0.3	1.2±0.2 b
	NT3	1.5±0.1	1.5±0.03	3.6±1.0	4.1±0.2	4.0±0.3	3.3±0.6	1.9±0.7	4.0±0.6	2.3±0.1	1.7±0.05	1.6±0.1 b
	NT4	1.5±0.03	2.3±0.02	3.9±0.5	4.8±1.6	5.0±2.0	4.4±0.7	5.1±2.3	4.6±0.8	1.9±0.1	2.8±0.5	3.1±0.8 a
UV-329	NT2	2.3±0.3	3.5±0.7	4.5±0.2	8.7±0.9	12.7±0.02	3.8±1.4	3.2±1.9	5.7±1.5	2.7±0.1	1.3±0.2	1.7±0.1 b
	NT3	6.2±0.4	3.9±0.5	13.9±8.4	17.9±9.4	16.8±2.9	16.7±3.6	8.8±4.2	15.9±3.3	5.5±1.1	2.8±0.5	3.3±0.6 b
	NT4	5.1±0.2	7.5±2.3	15.7±7.4	21.4±14.1	31.1±18.1	22.6±7.5	28.1±9.9	27.9±3.4	5.7±0.1	7.9±0.8	8.7±2.5 a
UV-P	NT2	1.7±0.1	1.6±0.2	1.6±0.1	3.6±1.8	5.4±0.5	1.9±0.2	2.2±0.4	2.9±1.9	2.2±0.4	1.6±0.004	< LOQ <sup>c</sup>
	NT3	2.3±0.7	1.9±0.3	5.5±2.5	6.0±0.6	7.2±0.7	3.6±0.2	3.2±0.5	4.0±0.4	2.1±0.4	1.6±0.01	< LOQ
	NT4	2.4±0.2	3.0±1.3	4.5±2.1	9.3±4.5	10.9±2.9	4.4±0.7	9.1±3.5	4.2±0.3	2.3±0.1	2.1±0.3	2.6±0.3

<sup>a</sup> Mean (ng/g) ± standard deviation (%) (n = 4, replicate samples at the same time).

<sup>b</sup> Letters (a and b) indicate the significant difference of concentration data by Duncan's multiple range test,  $p < 0.05$ .

<sup>c</sup> < LOQ: below the limit of quantification.