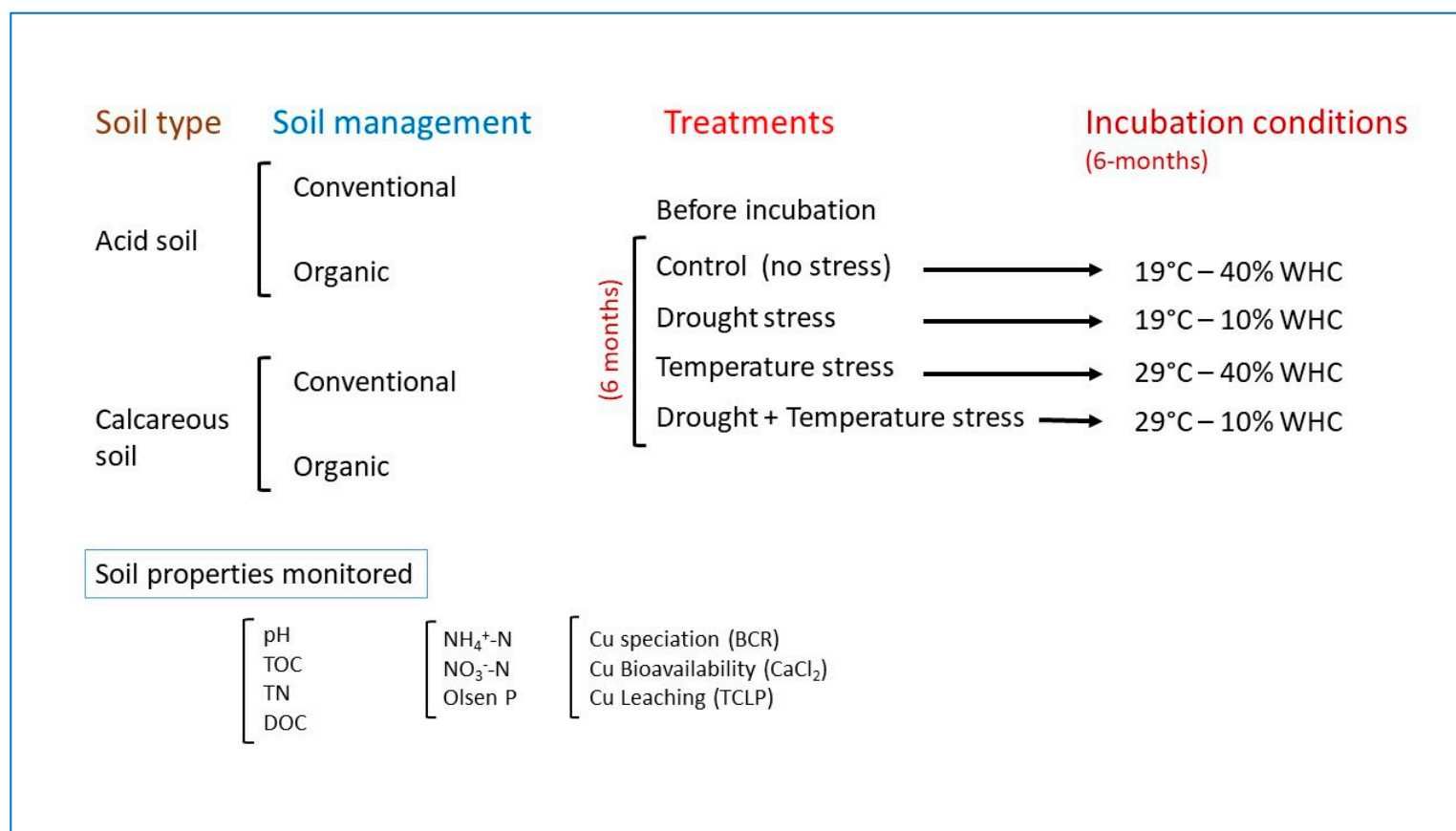


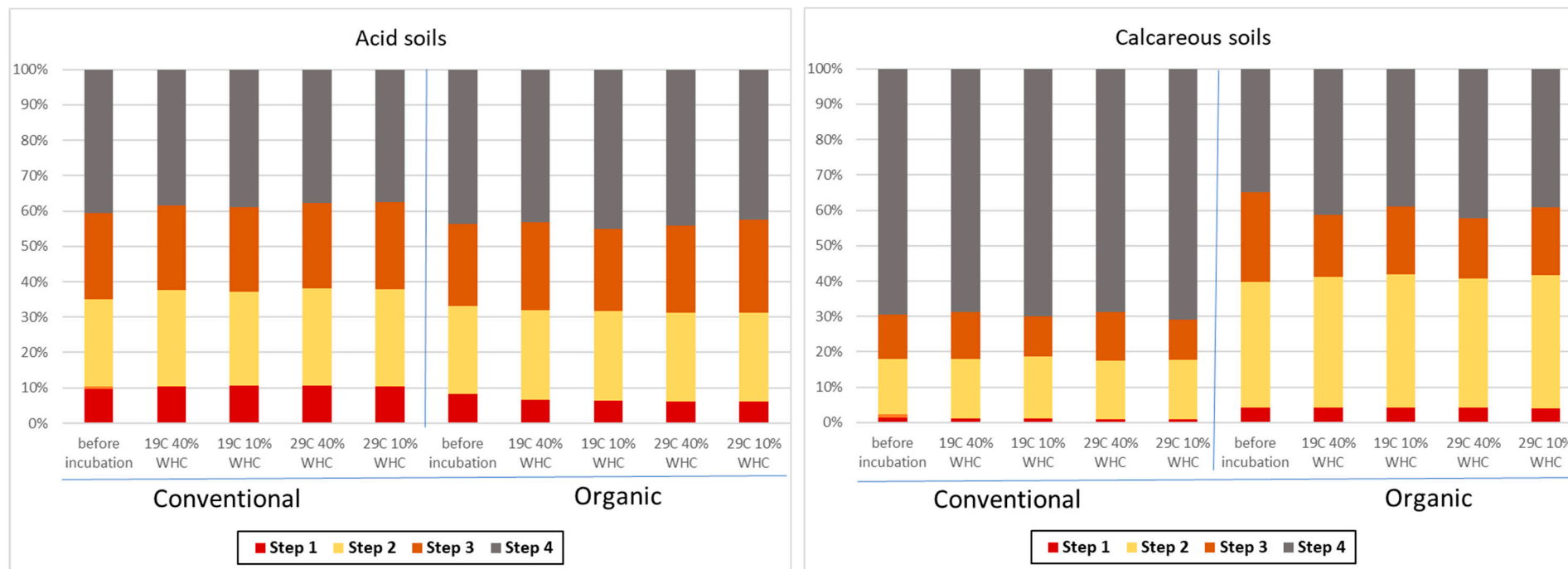
# Copper bioavailability and leaching in conventional and organic viticulture under environmental stress

Erika Jez, Elisa Pellegrini and Marco Contin

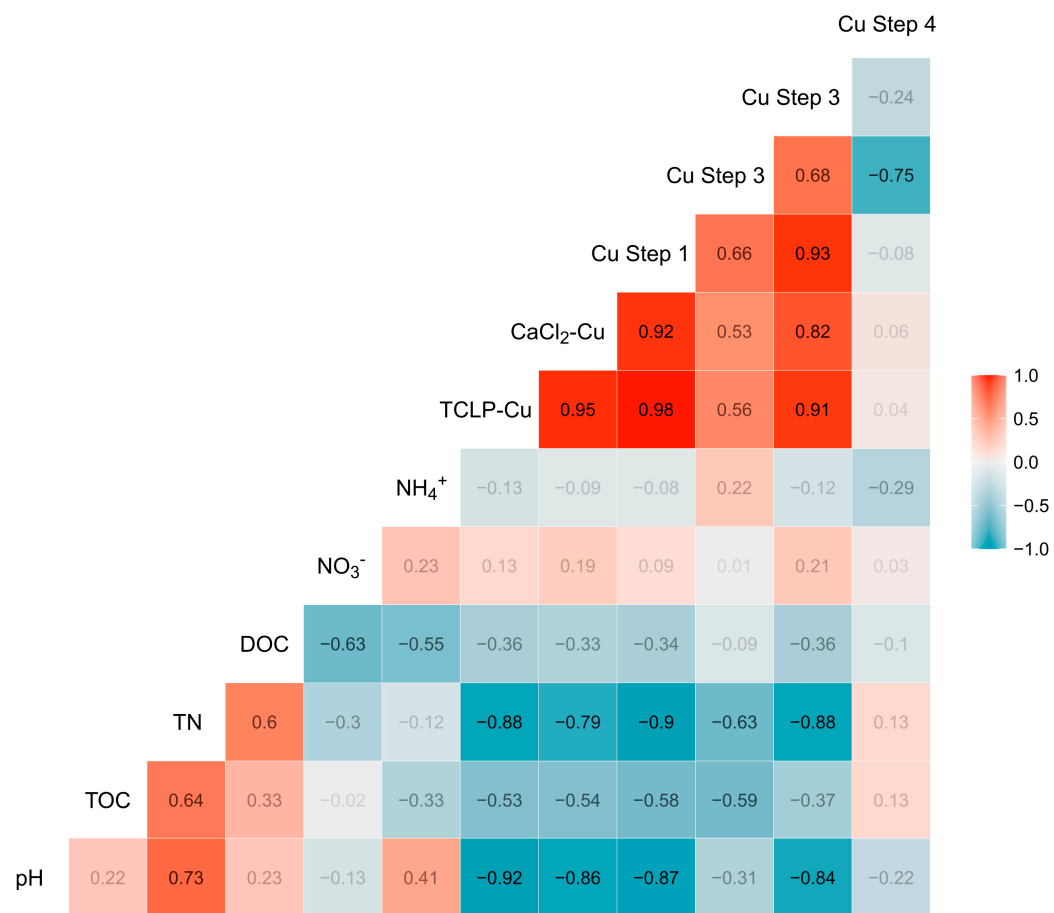
## Supplementary Material



**Figure S1.** Experimental layout.



**Figure S2.** Cu speciation in acid and calcareous soils (expressed as percentage) with BCR four steps sequential extraction procedure before and after 6-months incubation under moisture, temperature and combined stresses.



**Figure S3.** Correlation table of soil properties. Red color cells show positive P values, blue color negative P values, and shaded cells show not significant correlations.

**Table S1.** Two-way ANOVA output testing the significant effects of soil type, soil management or their interaction on soil properties.

Soil variable	Degrees of freedom	F value	P value	
<b>pH</b>				
Soil	1	25812.64	4.27E-48	*
Management	1	2987.406	3.56E-33	*
Soil:Management	1	483.4252	7.03E-21	*
<b>TOC</b>				
Soil	1	10.0911	0.003292	*
Management	1	198.335	2.89E-15	*
Soil:Management	1	1070.565	3.6E-26	*
<b>TN</b>				
Soil	1	796.2632	3.51E-24	*
Management	1	6.368421	0.016779	*
Soil:Management	1	296.0526	9.87E-18	*
<b>C/N</b>				
Soil	1	396.8632	1.34E-19	*
Management	1	83.46219	1.97E-10	*
Soil:Management	1	154.0533	8.96E-14	*
<b>DOC</b>				
Soil	1	197.8791	2.98E-15	*
Management	1	3.810882	0.059717	
Soil:Management	1	0.006728	0.935139	
<b>NH<sub>4</sub><sup>+</sup>-N</b>				
Soil	1	64.22818	3.78E-09	*
Management	1	36.58423	9.43E-07	*
Soil:Management	1	94.91414	4.28E-11	*
<b>NO<sub>3</sub><sup>-</sup>-N</b>				
Soil	1	48.16387	7.37E-08	*
Management	1	14.99207	0.000501	*

Soil:Management	1	21.21406	6.22E-05	*
<b>Olsen P</b>				
Soil	1	7669.742	1.11E-39	*
Management	1	9490.524	3.71E-41	*
Soil:Management	1	878.3294	7.74E-25	*
<b>Cu-CaCl<sub>2</sub></b>				
Soil	1	11716.36	1.29E-42	*
Management	1	2412	1.05E-31	*
Soil:Management	1	4449.493	6.41E-36	*
<b>Cu-TCPL</b>				
Soil	1	6747.347	8.52E-39	*
Management	1	780.125	4.82E-24	*
Soil:Management	1	1810.014	9.71E-30	*
<b>Cu Step 1</b>				
Soil	1	10141.08	1.29E-41	*
Management	1	665.3883	5.53E-23	*
Soil:Management	1	4430.303	6.87E-36	*
<b>Cu Step 2</b>				
Soil	1	338.7823	1.38E-18	*
Management	1	406.382	9.42E-20	*
Soil:Management	1	2117.297	8.22E-31	*
<b>Cu Step 3</b>				
Soil	1	1182.457	7.65E-27	*
Management	1	7.072343	0.012126	*
Soil:Management	1	216.114	8.75E-16	*
<b>Cu Step 4</b>				
Soil	1	1.297658	0.263097	
Management	1	594.0995	3.11E-22	*
Soil:Management	1	249.7825	1.13E-16	*

**Table S2.** One-way ANOVA output testing the significant effects of the imposed stress (temperature, moisture or their interaction) on soil properties within each soil type and management practice (i.e. calcareous conventional, calcareous organic, acid conventional, acid organic).

Soil variable	Soil type and management	Degrees of freedom	F value	P value	
pH	<b>Acid conventional</b>				
	Stress	3	115.3	6.37E-07	*
	<b>Acid organic</b>				
	Stress	3	131.5	3.81E-07	*
	<b>Calcareous conventional</b>				
	Stress	3	58.69	6.6E-07	*
TOC	<b>Calcareous organic</b>				
	Stress	3	149	2.33E-07	*
	<b>Acid conventional</b>				
	Stress	3	0.158	0.922	
	<b>Acid organic</b>				
	Stress	3	13.78	0.00159	*
TN	<b>Calcareous conventional</b>				
	Stress	3	10.24	0.00146	*
	<b>Calcareous organic</b>				
	Stress	3	13.13	0.00186	*
	<b>Acid conventional</b>				
	Stress	3	0.25	0.859	
C/N	<b>Acid organic</b>				
	Stress	3	4.97	0.031	*
	<b>Calcareous conventional</b>				
	Stress	3	15.1	0.000306	*
	<b>Calcareous organic</b>				
	Stress	3	39.33	3.9E-05	*

	<b>Acid organic</b>				
	Stress	3	0.923	0.472	
	<b>Calcareous conventional</b>				
	Stress	3	4.11	0.0318	*
	<b>Calcareous organic</b>				
	Stress	3	1.154	0.385	
<b>DOC</b>	<b>Acid conventional</b>				
	Stress	3	12.43	0.00222	*
	<b>Acid organic</b>				
	Stress	3	35.41	5.75E-05	*
	<b>Calcareous conventional</b>				
	Stress	3	276.3	3.45E-10	*
	<b>Calcareous organic</b>				
	Stress	3	215	5.52E-08	*
<b>NH<sub>4</sub><sup>+</sup>-N</b>	<b>Acid conventional</b>				
	Stress	3	27.94	0.000137	*
	<b>Acid organic</b>				
	Stress	3	4.398	0.0417	*
	<b>Calcareous conventional</b>				
	Stress	3	8.257	0.00328	*
	<b>Calcareous organic</b>				
	Stress	3	108.9	7.96E-07	*
<b>NO<sub>3</sub><sup>-</sup>-N</b>	<b>Acid conventional</b>				
	Stress	3	413.7	4.13E-09	*
	<b>Acid organic</b>				
	Stress	3	16.14	0.000937	*
	<b>Calcareous conventional</b>				
	Stress	3	101.3	4.76E-08	*
	<b>Calcareous organic</b>				
	Stress	3	1250	5.05E-11	*
<b>Olsen P</b>	<b>Acid conventional</b>				
	Stress	3	16.85	0.000809	*

	<b>Acid organic</b>				
	Stress	3	4.69	0.0358	*
	<b>Calcareous conventional</b>				
	Stress	3	5.598	0.0125	*
	<b>Calcareous organic</b>				
	Stress	3	6.521	0.0153	*
<hr/>					
<b>Cu-CaCl<sub>2</sub></b>	<b>Acid conventional</b>				
	Stress	3	327	1.05E-08	*
	<b>Acid organic</b>				
	Stress	3	27.83	0.000139	*
	<b>Calcareous conventional</b>				
	Stress	3	81.83	1.34E-07	*
<b>Cu-TCLP</b>	<b>Calcareous organic</b>				
	Stress	3	12.25	0.00233	*
	<b>Acid conventional</b>				
	Stress	3	6.353	0.0164	*
	<b>Acid organic</b>				
	Stress	3	10.91	0.00336	*
<b>Cu Step 1</b>	<b>Calcareous conventional</b>				
	Stress	3	80.82	1.42E-07	*
	<b>Calcareous organic</b>				
	Stress	3	6.069	0.0186	*
	<b>Acid conventional</b>				
	Stress	3	0.408	0.752	
<b>Cu Step 2</b>	<b>Acid organic</b>				
	Stress	3	3.73	0.0606	
	<b>Calcareous conventional</b>				
	Stress	3	23.79	4.3E-05	*
	<b>Calcareous organic</b>				
	Stress	3	0.694	0.581	
<hr/>					
<b>Cu Step 2</b>	<b>Acid conventional</b>				
	Stress	3	1.525	0.281	



	<b>Acid organic</b>				
	Stress	3	0.785	0.535	
	<b>Calcareous conventional</b>				
	Stress	3	1.693	0.228	
	<b>Calcareous organic</b>				
	Stress	3	4.68	0.0359	*
<hr/>					
<b>Cu Step 3</b>	<b>Acid conventional</b>				
	Stress	3	1.092	0.407	
	<b>Acid organic</b>				
	Stress	3	1.728	0.238	
	<b>Calcareous conventional</b>				
	Stress	3	6.242	0.00874	*
	<b>Calcareous organic</b>				
	Stress	3	6.283	0.0169	*
<hr/>					
<b>Cu Step 4</b>	<b>Acid conventional</b>				
	Stress	3	2.673	0.118	
	<b>Acid organic</b>				
	Stress	3	0.601	0.632	
	<b>Calcareous conventional</b>				
	Stress	3	3.606	0.0455	
	<b>Calcareous organic</b>				
	Stress	3	2.412	0.142	
<hr/>					

**Table S3.** Cu-bioavailability and Cu-leaching form polluted vineyard soils before and after 6-months incubation under moisture, temperature and combined stresses.

	Soil type	Treatment	Soil pH	Bioavailability (CaCl <sub>2</sub> extraction)		Leaching (TCLP extraction)			
				pH	Cu (mg kg <sup>-1</sup> )	Cu %	pH	Cu (mg kg <sup>-1</sup> )	Cu %
Acid soils	Conventional	Before incubation	5.05	5.12	0.55	0.38	3.58	3.29	2.30
		19°C 40%WHC	5.34	4.95	0.63	0.44	3.54	4.87	3.40
		19°C 10%WHC	5.42	5.22	0.50	0.35	3.57	4.46	3.11
		29°C 40%WHC	4.93	4.80	0.95	0.66	3.52	5.04	3.52
		29°C 10%WHC	5.08	5.08	0.52	0.36	3.55	4.34	3.03
	Organic	Before incubation	5.69	5.73	0.41	0.31	3.66	2.87	2.18
		19°C 40%WHC	5.92	6.37	0.27	0.21	3.72	2.32	1.76
		19°C 10%WHC	6.07	6.32	0.28	0.21	3.78	2.25	1.71
		29°C 40%WHC	6.21	6.48	0.22	0.17	3.69	1.97	1.50
		29°C 10%WHC	6.28	6.44	0.25	0.19	3.72	2.21	1.68
Calcareous soils	Conventional	Before incubation	7.54	7.28	0.12	0.11	4.55	0.37	0.35
		19°C 40%WHC	7.11	7.47	0.05	0.05	4.51	0.26	0.25
		19°C 10%WHC	7.02	7.40	0.07	0.07	4.59	0.26	0.25
		29°C 40%WHC	7.94	7.56	0.04	0.04	4.46	0.21	0.20
		29°C 10%WHC	7.20	7.43	0.05	0.05	4.52	0.27	0.26
	Organic	Before incubation	7.35	7.64	0.32	0.24	5.28	1.15	0.87
		19°C 40%WHC	8.13	7.73	0.11	0.08	5.54	0.70	0.53
		19°C 10%WHC	7.63	7.64	0.13	0.10	5.56	0.73	0.55
		29°C 40%WHC	8.08	7.74	0.10	0.08	5.17	0.82	0.62
		29°C 10%WHC	7.35	7.72	0.12	0.09	5.27	0.88	0.66