Supplementary Information

Effect of Cu-doped carbon nanoparticle (CuCNP) on *Vigna radiata*

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Statistical Analysis (t-Test)

Morphology

Control vs 0.05 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Root Length	1.161	.313	2.037	6.764	.082
Shoot Length	.056	.819	1.153	8	.282
Fresh weight	.547	.493	.995	4.829	.367
Dry weight	.065	.812	2.652	4	.057

Control vs 0.1 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Root Length	4.469	.067	2.733	5.202	.039
Shoot Length	.304	.596	4.452	8	.002
Fresh weight	2.559	.185	2.476	2.129	.124
Dry weight	5.000	.089	5.612	2.306	.022

Control vs 0.5 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Root Length	6.067	.039	5.013	4.741	.005
Shoot Length	.839	.387	4.422	6.329	.004
Fresh weight	1.770	.241	6.999	4.773	.001
Dry weight	1.565	.279	6.548	3.124	.006

Control vs 1 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Root Length	6.957	.030	6.380	4.569	.002
Shoot Length	.004	.954	8.148	8	.000
Fresh weight	.020	.894	15.618	5	.000
Dry weight	5.000	.089	9.621	2.306	.007

CS vs CuCNP (0.05 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Root Length	11.388	.010	8.130	5.280	.000
Shoot Length	.140	.718	4.933	8	.001
Fresh weight	1.421	.278	1.860	3.786	.140

Dry weight	.643	.468	4.903	3.298	.013

CS vs CuCNP (0.1 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Root Length	.313	.591	5.137	8	.001
Shoot Length	.178	.684	3.842	8	.005
Fresh weight	.059	.818	10.928	5	.000
Dry weight	2.571	.184	7.778	2.560	.008

CS vs CuCNP (0.5 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Root Length	.837	.387	4.647	7.315	.002
Shoot Length	2.237	.173	-.353	4.947	.739
Fresh weight	6.380	.053	6.307	3.201	.007
Dry weight	.235	.653	3.618	4	.022

CS vs CuCNP (1 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Root Length	4.885	.058	1.836	5.528	.120
Shoot Length	.830	.389	-3.358	7.295	.011

Fresh weight	1.226	.311	6.417	4.228	.003
Dry weight	2.571	.184	3.536	2.560	.049

Chlorophyll content

Control vs 0.05 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
chlorophyll a content	.581	.489	10.510	3.281	.001
chlorophyll b content	3.911	.119	2.059	2.057	.172

Control vs 0.1 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
chlorophyll a content	12.931	.023	.681	2.035	.565
chlorophyll b content	3.889	.120	9.431	2.051	.010

Control vs 0.5 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
chlorophyll a content	1.747	.257	26.295	2.647	.000
chlorophyll b content	3.706	.127	13.200	2.071	.005

Control vs 1 mg/L CS

Parameter	Levene's Test for Equality of Variances	t-test for equality of means

	F	Sig	t	df	Sig
chlorophyll a content	1.185	.338	33.410	2.934	.000
chlorophyll b content	3.404	.139	14.281	2.115	.004

CS vs CuCNP (0.05 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
chlorophyll a content	.216	.666	81.099	4	.000
chlorophyll b content	6.857	.059	21.579	2.205	.001

CS vs CuCNP (0.1 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
chlorophyll a content	15.444	.017	3.851	2.000	.061
chlorophyll b content	.142	.726	72.200	4	.000

CS vs CuCNP (0.5 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
chlorophyll a content	.000	1.000	27.939	4	.000
chlorophyll b content	4.483	.102	19.942	2.190	.002

CS vs CuCNP (1 mg/L)

Parameter	Levene's Test for Equality of Variances	t-test for equality of means

	F	Sig	t	df	Sig
chlorophyll a content	.795	.423	22.830	3.091	.000
chlorophyll b content	.001	.979	29.094	4	.000

Carotenoid content

Control vs 0.05 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Carotene content	2.099	.221	4.768	2.577	.025
Xanthophyll content	4.500	.101	12.961	2.306	.003

Control vs 0.1 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Carotene content	.030	.871	20.872	4	.000
Xanthophyll content	2.000	.230	27.713	3.200	.000

Control vs 0.5 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Carotene content	.270	.631	46.786	3.636	.000
Xanthophyll content	8.500	.043	13.889	2.116	.004

Control vs 1 mg/L CS

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Carotene content	.006	.940	74.500	4	.000

Xanthophyll content	4.000	.116	36.742	2.560	.000

CS vs CuCNP (0.05 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Carotene content	5.186	.085	48.499	2.096	.000
Xanthophyll content	.571	.492	22.978	3.427	.000

CS vs CuCNP (0.1 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Carotene content	10.112	.034	11.429	2.042	.007
Xanthophyll content	.400	.561	36.500	4	.000

CS vs CuCNP (0.5 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Carotene content	.536	.505	40.902	4	.000
Xanthophyll content	.945	.386	12.858	3.531	.000

CS vs CuCNP (1 mg/L)

Parameter	Levene's Test for Equality of Variances		t-test for equality of means		
	F	Sig	t	df	Sig
Carotene content	.530	.507	43.583	4	.000
Xanthophyll content	.000	1.000	15.276	4	.000

Anova Test

1. Morphology

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.
Treatment type	Pillai's Trace	.947	66.629[a]	4.000	15.000	.000

	Wilks' Lambda	.053	66.629[a]	4.000	15.000	.000
	Hotelling's Trace	17.768	66.629[a]	4.000	15.000	.000
	Roy's Largest Root	17.768	66.629[a]	4.000	15.000	.000
Concentration	Pillai's Trace	1.336	3.411	12.000	51.000	.001
	Wilks' Lambda	.013	13.807	12.000	39.978	.000
	Hotelling's Trace	49.050	55.862	12.000	41.000	.000
	Roy's Largest Root	48.520	206.209[b]	4.000	17.000	.000
Treatment type * Concentration	Pillai's Trace	1.174	2.731	12.000	51.000	.006
	Wilks' Lambda	.133	3.800	12.000	39.978	.001
	Hotelling's Trace	4.359	4.965	12.000	41.000	.000
	Roy's Largest Root	3.862	16.413[b]	4.000	17.000	.000

Tests of Between-Subjects Effects

	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Treatment type	Root Length	6.202	1	6.202	37.713	.000
	Shoot Length	.427	1	.427	.845	.370
	Fresh weight	.005	1	.005	82.926	.000
	Dry weight	.000	1	.000	81.153	.000
Concentration	Root Length	22.538	3	7.513	45.686	.000
	Shoot Length	83.320	3	27.773	54.977	.000
	Fresh weight	.011	3	.004	64.981	.000
	Dry weight	.000	3	.000	42.562	.000

Treatment type * Concentration	Root Length	2.085	3	.695	4.226	.020
	Shoot Length	13.480	3	4.493	8.894	.001
	Fresh weight	.001	3	.000	6.474	.004
	Dry weight	2.712E-5	3	9.042E-6	3.699	.031

2. Chlorophyll content

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.
Treatment type	Pillai's Trace	.987	635.980[a]	2.000	17.000	.000
	Wilks' Lambda	.013	635.980[a]	2.000	17.000	.000
	Hotelling's Trace	74.821	635.980[a]	2.000	17.000	.000
	Roy's Largest Root	74.821	635.980[a]	2.000	17.000	.000
Concentration	Pillai's Trace	1.614	25.125	6.000	36.000	.000
	Wilks' Lambda	.005	75.663[a]	6.000	34.000	.000
	Hotelling's Trace	77.418	206.449	6.000	32.000	.000
	Roy's Largest Root	75.734	454.404[b]	3.000	18.000	.000
Treatment type * Concentration	Pillai's Trace	1.492	17.614	6.000	36.000	.000
	Wilks' Lambda	.059	17.751[a]	6.000	34.000	.000
	Hotelling's Trace	6.678	17.809	6.000	32.000	.000
	Roy's Largest Root	4.663	27.976[b]	3.000	18.000	.000

Tests of Between-Subjects Effects

	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Treatment type	chlorophyll a content	.281	1	.281	175.147	.000
	chlorophyll b content	.619	1	.619	1249.313	.000
Concentration	chlorophyll a content	.466	3	.155	96.689	.000
	chlorophyll b content	.594	3	.198	399.077	.000
Treatment type * Concentration	chlorophyll a content	.113	3	.038	23.452	.000
	chlorophyll b content	.027	3	.009	18.058	.000

3. Carotenoid content

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.
Treatment type	Pillai's Trace	.994	1399.836[a]	2.000	17.000	.000
	Wilks' Lambda	.006	1399.836[a]	2.000	17.000	.000
	Hotelling's Trace	164.687	1399.836[a]	2.000	17.000	.000
	Roy's Largest Root	164.687	1399.836[a]	2.000	17.000	.000
Concentration	Pillai's Trace	1.247	9.943	6.000	36.000	.000
	Wilks' Lambda	.005	71.131[a]	6.000	34.000	.000
	Hotelling's Trace	136.243	363.315	6.000	32.000	.000
	Roy's Largest Root	135.901	815.408[b]	3.000	18.000	.000
Treatment type * Concentration	Pillai's Trace	1.583	22.809	6.000	36.000	.000
	Wilks' Lambda	.023	31.916[a]	6.000	34.000	.000
	Hotelling's Trace	16.322	43.526	6.000	32.000	.000
	Roy's Largest Root	14.481	86.884[b]	3.000	18.000	.000

Tests of Between-Subjects Effects

	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Treatment type	carotene content	.685	1	.685	1542.562	.000
	xanthophyll content	.023	1	.023	1692.445	.000
Concentration	carotene content	.762	3	.254	571.699	.000
	xanthophyll content	.013	3	.004	316.323	.000
Treatment type * Concentration	carotene content	.054	3	.018	40.560	.000
	xanthophyll content	.003	3	.001	63.964	.000