NUMERICAL DATA

Influence of plant growth promoting *rhizobacterial* strains on growth, chlorophyll and protein content of Helianthus annuus under endosulfan stress (2019)

Plant growth, chlorophyll and protein content under endosulfan stress

		Control			*Paenibacillus* sp. IITISM08			*Bacillus* sp. PRB77			*Bacillus* sp. PRB101		
Parameters	Treatments	40	80	120	40	80	120	40	80	120	40	80	**120**
Root length	E_5	29.4	33.9	42.3	21.7	24.8	28.9	17.1	19.3	20.6	6.9	8.5	**10.3**
(%GI)	E_{10}	46.7	49.2	52.4	45.6	46.5	48.8	41.1	44.5	45.9	10.6	13.3	**15.8**
	E_{25}	53.6	56.9	62.5	50.9	54.0	57.6	48.2	50.1	54.3	23.6	25.6	**29.0**
	E_{50}	67.5	69.3	72.2	56.1	59.5	64.9	54.8	56.8	59.6	32.9	35.7	**38.2**
Shoot length	E_5	22.0	24.7	26.0	13.2	18.7	22.3	12.3	16.3	20.0	2.82	3.68	**4.79**
(%GI)	E_{10}	35.9	37.9	40.9	33.5	35.3	37.3	27.5	29.5	34.3	8.66	11.2	**13.8**
	E_{25}	49.7	51.8	54.5	42.6	45.6	47.3	39.6	43.1	45.2	19.5	21.5	**23.6**
	E_{50}	64.6	66.2	67.8	57.6	60.7	62.2	54.3	56.3	58.3	23.5	25.9	**27.5**
Root weight	E_5	32.8	34.2	36.4	28.6	31.9	33.1	24.0	27.5	31.8	3.37	4.02	**5.31**
(%GI)	E_{10}	41.9	44.2	46.3	38.2	41.3	44.2	35.3	36.9	40.0	6.74	10.3	**11.8**
	E_{25}	54.8	59.9	61.0	51.5	54.0	58.4	47.3	50.4	55.5	21.3	26.8	**28.5**
	E_{50}	79.7	83.3	84.4	76.1	78.8	81.5	71.6	75.6	78.1	37.9	41.9	**42.9**
Shoot weight	E_5	25.9	29.7	34.0	20.9	24.2	30.9	23.5	26.0	28.8	3.15	3.57	**4.49**
(%GI)	E_{10}	40.8	43.0	46.5	37.3	39.7	41.9	33.1	35.9	38.1	7.20	9.26	**13.0**
	E_{25}	56.0	59.0	62.6	51.9	55.8	59.0	44.9	49.4	51.6	12.6	14.9	**17.7**
	E_{50}	69.8	73.1	76.7	64.4	69.3	73.8	61.9	63.6	64.4	15.7	18.1	**20.8**
Chlorophyll	E_5	41.9	44.3	46.6	32.7	38.3	43.6	26.5	31.4	37.5	6.2	9.8	**10.6**
content (%GI)	E_{10}	50.5	53.9	57.4	45.4	49.3	53.6	43.0	46.6	50.0	12.5	15.4	**19.5**
	E_{25}	63.4	68.6	72.9	61.8	65.7	69.0	58.2	60.9	63.9	30.7	35.9	**41.4**
	E_{50}	75.2	77.3	79.0	69.0	73.9	77.2	67.0	71.4	74.2	48.8	56.3	**61.5**
Protein	E_5	31.4	34.3	36.5	24.1	28.3	32.5	23.8	27.7	29.8	3.5	4.1	**5.54**
content (%GI)	E_{10}	38.4	43.0	48.2	37.6	41.3	46.9	30.7	35.9	41.8	13.5	16.3	**18.8**
	E_{25}	47.3	52.2	57.7	46.2	49.1	55.5	45.8	48.7	51.3	18.0	22.5	**25.6**
	E_{50}	**63.9**	**66.4**	**69.6**	**60.0**	**64.7**	**67.8**	**54.4**	**58.7**	**62.4**	**25.7**	**27.5**	**29.8**

*Note: E5, E10, E25 and E50 are representing the amendment of 5, 10, 25 and 50 mg kg−1 endosulfan, respectively in soil Control (without inoculum)

%GI (Growth inhibition) = 100 * (Pc - Pt) / Pc (where Pc; root or shoot length/root or shoot weight/ chlorophyll or protein content of the control (E0) and Pt is the root or shoot length/root or shoot weight/ chlorophyll or protein content of the treated 458 samples).

Endosulfan induced growth (length and weight of root and shoot) inhibition along with the inhibition of chlorophyll and protein content of H. annuus. Inhibition of these parameters increased with increasing the dose of endosulfan (5- 50 mg Kg-1). Presence of plant growth promoting rhizobacterial strains, i.e., Paenibacillus sp. IITISM08, Bacillus sp. PRB77 and Bacillus sp. PRB101. Highest reduction in inhibition of same was observed in presence of by Bacillus sp. PRB101

Source: https://sci-hub.tw/10.1016/j.chemosphere.2019.03.037

Effect of endosulfan tolerant bacterial isolates (Delftia lacustris IITISM30 and Klebsiella aerogenes IITISM42) with Helianthus annuus on remediation of endosulfan from contaminated soil (2019)

Effect of endosulfan on plant growth, chlorophyll content and protein content of H. Annuus

Growth Parameter	Treatments	Strains			
		Control (without inoculum)	IITISM30	IITISM42	Mixture
Root length (% GI)	E5	42.3	19.2	12.1	4.3
	E10	52.4	30.7	17.1	18.4
	E25	62.5	40.0	32.5	28.7
	E50	72.2	52.2	44.6	42.5
Shoot length (% GI)	E5	26.0	11.0	7.7	5.4
	E10	40.9	20.0	14.3	13.5
	E25	54.5	29.4	26.2	24.0
	E50	67.8	40.2	28.9	32.0
Root weight (% GI)	E5	36.4	10.3	6.7	3.1
	E10	46.3	12.5	17.2	8.4
	E25	61.0	32.5	30.7	13.8
	E50	84.4	68.5	64.5	23.2
Shoot weight (% GI)	E5	34.0	5.8	5.0	3.6
	E10	46.5	18.3	15.7	4.5
	E25	62.6	41.2	19.7	14.4
	E50	76.7	56.3	33.2	34.6
Chlorophyll (% GI)	E5	46.6	14.8	11.4	10.6
	E10	57.4	25.7	22.8	29.5
	E25	72.9	47.5	46.4	43.9
	E50	79.0	61.3	63.1	56.8
Protein(% GI)	E5	36.5	15.3	6.4	8.4
	E10	48.2	19.5	22.1	19.1
	E25	57.7	31.7	25.7	22.0
	E50	69.6	42.7	32.5	32.9

Note: E5 (soil+5 mg kg−1 endosulfan), E10 (soil+10 mg kg−1 endosulfan), E25 (soil+25 mg kg−1 endosulfan), E50 (soil+50 mg kg−1 endosulfan). Mixture; consortium of IITISM30 +IITISM42

% GI (Growth inhibition) = 100 * (Pc - Pt) / Pc (where Pc is the root length or shoot length or root weight or shoot weight or chlorophyll content or protein content of the control (E0) and Pt is the root length or shoot length or root weight or shoot weight or chlorophyll content or protein content of the treated samples).

Source: http://sci-hub.tw/https://doi.org/10.1016/j.ecoenv.2018.10.059

Biodiversity and threats in non-protected areas: A multidisciplinary and multi-taxa approach focused on the Atlantic Forest (2019)

Pesticide concentrations in surface water (ng/L) and bottom sediments (ng/g dry wet) from the Ramos Creek (mean T standard deviation).

	Surface water	Bottom sediments
Trifluralin	0.0002 T 0.00016	0.0002 T 0.00001
Chlorothalonil	0.0033 T 0.0015	0.00064 T 0.00064
Chlorpyriphos	0.30 T 0.14	0.74 T 0.13
α-HCH	0.14 T 0.07	0.05 T 0.02
γ-HCH	0.08 T 0.04	<dl
ΣHCHs	0.23 T 0.04	0.05 T 0.02
Heptachlor	<dl	0.09 T 0.04
Hept. epoxide	0.07 T 0.03	<dl
ΣHeptachlors	0.07 T 0.03	0.09 T 0.04
γ-chlordane	0.08 T 0.04	0.07 T 0.01
α-chlordane	0.03 T 0.01	<dl
ΣChlordanes	0.11 T 0.03	0.07 T 0.01
α-endosulfan	0.03 T 0.01	0.08 T 0.01
β-endosulfan	0.36 T 0.17	<dl
ΣEndosulfans	4.07 T 2.37	0.08 T 0.01
pp´-DDE	0.16 T 0.08	<dl
pp´-DDD	0.35 T 0.16	<dl
ΣDDTs	0.51 T 0.13	<dl

dl: detection limit

Bottom sediments showed a different pesticide pattern distribution. Chlorpyrifos concentrations were the highest (0.75 ng/g dry wet, Endosulfans, chlordanes and heptachlor (0.08, 0.07 and 0.09 ng/g dry wet, respectively, account for 30% each one of the total organochlorine pesticide levels.

Source: https://www.sciencedirect.com/science/article/pii/S2405844019359523

Phytoremediation of Endosulfan Sulfate-Contaminated Soil by Single and Mixed Plant Cultivations. (2018)

Table 1: Concentrations of endosulfan sulfatein shoot and root of sweet corn, cucumber, and cowpea grown in endosulfan sulphate contaminated soil for 25 days

Plant tissues	**Amount accumulation**
	(µg/plant shoot or µg/plant root)
Sweet corn shoot	
SC	BD
SC + CU	4.4±0.0a
SC + CP	BD
Cucumber shoot	
CU	14.3±8.1a
CU + SC	10.5±4.0a
CU + CP	BD
Cowpea shoot	
CP	18.1±1.1a
CP + SC	BD
CP + CU	20.3±2.2a
Sweet corn root	
SC	BD
SC + CU	0.2±0.0c
SC + CP	16.3±5.5bc
Cucumber root	
CU	17.0±5.9abc
CU + SC	34.4±11.0a
CU + CP	BD
Cowpea root	
CP	22.6±3.1ab
CP + SC	17.1±5.5abc
CP + CU	8.1±3.7bc

Different lower case letters denote significant difference ($P<0.05$) between the same plant on the same day SC sweet corn, CU cucumber, CP cowpea, NA not available because the plant died, BD below detection limit at 0.2 µg/plant.

Source: https://link.springer.com/article/10.1007/s11270-014-1886-0

Endosulfan Plant Uptake Suppression Effect on Char Amendment in Oriental Radish.(2018)

Table 1: BCF concentration and TF of endosulfan in oriental radish at harvest

	Root				**Aerial part**				**TF**	**BCF[a]**
	α	β	Sulfate	Total	α	β	Sulfate	Total		
Untreat	0.021	0.026	0.165	0.212	0.001	0.002	0.031	0.034	0.160	0.025
PAC	0.005	0.008	0.057	0.070	0.001	0.002	0.023	0.026	0.371	0.006
POC	0.001	0.001	0.010	0.012	0.001	0.001	0.004	0.005	0.417	0.002
GOC	0.021	0.028	0.246	0.295	0.002	0.001	0.043	0.046	0.156	0.028
RHC	0.018	0.021	0.143	0.182	0.001	0.002	0.035	0.038	0.209	0.021

PAC powdered activated carbon, POC powdered oak char, GOC granulated oak char, RHC rice husk char, TF translocation factor from root to aerial part of the radish. BCF was calculated with total endosulfan residue in the root of radish.

To survey the BCF for the radish in farm level, two sites contaminated with endosulfan (2.274 and 51.00 mg kg−1) were selected at Gochang in South Korea. In this study, the BCF of endosulfans in the root was 0.015 and 0.071, respectively. The BCF of endosulfan sulfate was of the range 0.069–0.097. These BCFs for the radish were similar to the previous reports (Hwang et al. 2016).

Source: https://link.springer.com/article/10.1007/s11270-017-3677-x

Endosulfan Degradation by Selected Strains of Plant Growth Promoting Rhizobacteria (2017)

Table 1: PGP activities of the selected strains at varying concentrations of endosulfan

Strains number	Treatments	Solubilization Index[a]	P-liberated in broth assay (µg mL^{-1})[b]	Change in pH	IAA ($\mu g\ mL^{-1}$)	Siderophore zone size (mm)	HCN	NH_3
PRB08	Control	3.2 ± 0.15[a]	174.3 ± 1.5[a]	3.1 ± 0.17	67.0 ± 1.0[a]	11 ± 1.5[a]	+	+
	1X	3.0 ± 0.05[ab]	170.0 ± 1.0[b]	3.1 ± 0.15	65.3 ± 2.0[ab]	11 ± 1.5[a]	+	+
	2X	2.9 ± 0.05[b]	167.3 ± 1.5[b]	3.2 ± 0.11	61.3 ± 1.5[b]	11 ± 1.7[a]	+	+
PRB44	Control	3.0 ± 0.15[a]	167.0 ± 2.0[a]	3.1 ± 0.10	66.3 ± 1.5[a]	10 ± 2.0[a]	+	+
	1X	2.8 ± 0.10[a]	165.3 ± 1.5[ab]	3.1 ± 0.15	62.6 ± 2.5[ab]	9 ± 0.5[a]	+	+
	2X	2.7 ± 0.20[a]	162.6 ± 1.5[b]	3.1 ± 0.05	59.3 ± 0.5b	9 ± 1.0[a]	+	+
PRB77	Control	2.9 ± 0.10[a]	185.6 ± 2.5[a]	2.7 ± 0.30	67.6 ± 1.5[a]	13 ± 0.5[a]	+	+
	1X	3.1 ± 0.10[a]	181.3 ± 1.5[ab]	2.7 ± 0.36	68.6 ± 1.5[a]	13 ± 0.5[a]	+	+
	2X	3.0 ± 0.05[a]	177.3 ± 1.6[b]	2.9 ± 0.20	64.3 ± 2.5[a]	12 ± 0.5[a]	+	+
PRB90	Control	2.8 ± 0.15[a]	153.0 ± 2.0[a]	3.2 ± 0.05	57.3 ± 2.0[a]	10 ± 1.0[a]	+	+
	1X	2.6 ± 0.10[a]	150.3 ± 3.2[a]	3.2 ± 0.10	55.3 ± 1.5[a]	8 ± 0.5[a]	+	+
	2X	2.5 ± 0.20[a]	147.3 ± 3.2[a]	3.3 ± 0.05	52.6 ± 2.0[a]	7 ± 1.0[a]	+	+
PRB101	Control	3.3 ± 0.10[a]	189.3 ± 3.5[a]	2.7 ± 0.20	74.0 ± 2.6[a]	13 ± 1.5[a]	+	+
	1X	3.3 ± 0.15[a]	186.6 ± 3.0[a]	2.8 ± 0.15	71.3 ± 2.5[ab]	13 ± 0.5[a]	+	+
	2X	3.2 ± 0.15[a]	183.0 ± 1.0[a]	3.0 ± 0.05	67.3 ± 1.5[b]	13 ± 1.0[a]	+	+

Values represent Mean ± SD (n = 3). Different subscript letters represent significant differences along the column of individual strains in the solubilization indexes, P-liberated in broth assay, IAA and Siderophore zone size at $p \leq 0.05$ according to Tukey's test X recommended field dose, IAA indole-3-acetic acid, HCN hydrogen cyanide, NH3 ammonia a Solubilization index = Total diameter (colony diameter + halo zone)/colony diameter b Amount of P liberated in NBRIP broth after 6 days of incubation with pesticide amendment

Source:
https://www.researchgate.net/publication/316853194_Endosulfan_Degradation_by_Selected_Strains_of_Plant_Growth_Promoting_Rhizobacteria

Recovery of lindane and α- and β- endosulfan from soil samples spiked at three levels (2016)

Lindane			α- endosulfan			β- endosulfan		
Amount added ngg^{-1}	Amount found ngg^{-1}	% Recovery	Amount added ngg^{-1}	Amount found ngg^{-1}	% Recovery	Amount added ngg^{-1}	Amount found ngg^{-1}	% Recovery
3.01	2.50	83	2.48	2.10	85	2.53	2.20	87
6.32	5.00	80	5.00	4.20	84	5.04	4.40	87
9.32	9.04	97	9.00	8.93	99	9.83	9.77	99

Source: M.f. zaranyika, P. Mugari (2016), Soil persistence, plant and non-target insect uptake of endosulfan and lindane applied to soya bean and maize in field trials in zimbabwe, Chemistry Department, University of Zimbabwe