Quality assessment in wild strawberry fruit and basil leaf from plants cultivated on dredged remediated sediment (SUBSED - LIFE17 ENV/IT/000347)

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SEDIMENT-BASED SUBSTRATE

Sediments, dredged from the Leghorn port in 2008-2009, were subjected to phytoremediation for three years. The phyto-remediated sediment underwent landfarming (periodical aeration and irrigation by mechanical handling) for three months prior to their use for plant cultivation. The treated sediment was used alone or mixed with peat-based substrate (60% peat, 40% pumice) to obtain the following treatments: TS100 (100% treated sediment), TS50 (1/1 peat-based substrate/treated sediment v/v), and TS0 (100% peat-based substrate) considered as the control treatment.

PLANT MATERIAL

Basil and wild strawberry were chosen as model plant species since they are good indicators of the chemical and physical quality of the tested substrates. Basil (*Ocimum basilicum* L.) seeds, cvs. Genovese and Valentino, and certified wild strawberry (*Fragaria vesca* L.), cv. Regina delle Valli were used as plant material.

EXPERIMENTAL DESIGN

Wild strawberry	Basil
Environment: greenhouse	
Substrate mixture: TS100, TS50, TS0	
Water regime:	
WR1 - normal WR2 - low (reduced by 30%) WR3 - very low (reduced by 50%)	
Plantlets/substrate * water regime plot:	**Seeds/substrate * water regime * cultivar plot:**
5 in 50-L boxes	276 seeds in 12 0.5-L pots (23 seeds/pot)
Plot replicates: 3	
Total strawberry plantlets:	**Total seeds per cultivar:**
90	7452

RESULTS

Physicochemical characteristics	TS0	TS50	TS100	L.D. 75/2010	L.D. 152/2006
Dry bulk density (g cm^{-3})	0.31	0.58	0.67	≤ 0.95	n.a
Porosity (%)	90.1	75.1	74.3	n.a	n.a
Air capacity (%)	25.6	19.5	6.0	n.a	n.a
Water capacity (%)	64.5	55.62	73.7	n.a	n.a
Easy available water (%)	21.4	11.2	21.5	n.a	n.a
EC (dS m^{-1})	0.40	0.28	0.20	≤ 1.0	n.a
pH	6.4	7.3	7.8	4.5-8.5	n.a
$N\text{-}NH_3$ (mg Kg^{-1})	277.0	29.2	2.2	n.a	n.a
$N\text{-}NO_3$ (mg Kg^{-1})	271.7	118.8	59.4	n.a	n.a
Humidity (%)	14.9	4.8	2.1	n.a	n.a
Total nitrogen (%)	1,3	0,3	0,1	n.a	n.a
Total organic carbon (%)	27,7	8,7	0,7	≥ 4	n.a
Phosphorus (g Kg^{-1})	518,0	715,0	662,0	n.a	n.a
Metals				n.a	n.a
Cu (mg Kg^{-1})	12.1	35.5	37.1	≤ 230	≤ 120
Zn (mg Kg^{-1})	18.1	167.4	188.5	≤500	≤150
Ni (mg Kg^{-1})	6.5	50.0	50.3	≤ 100	≤ 120
Cr (mg Kg^{-1})	5.2	64.1	59.4	n.a	≤ 150
Cr (VI) (mg Kg^{-1})	-	-	-	≤ 0.5	≤ 2
Pb (mg Kg^{-1})	20.6	35.9	49.5	≤ 140	≤ 100

PARTNERSHIP

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BASIL

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Substrate	Water regime	Total fresh weight (g)		Total leaf area (cm^2)	
		Genova	Valentino	Genova	Valentino
TS0	WR1	71	114	2041	3074
TS50	WR1	48	91	1448	2445
TS100	WR1	22	43	714	1082
TS0	WR2	77	109	2271	2850
TS50	WR2	57	89	1801	2402
TS100	WR2	20	36	700	1011
TS0	WR3	37	54	1369	1598
TS50	WR3	24	41	755	1268
TS100	WR3	13	21	487	611

TS0 - WR2 | TS50 - WR2 | TS100 - WR2

Factor/Parameter	Germination %
Cultivar	
Genova	60.2 ns
Valentino	57.2 ns
Substrate	
TS0 1	61.8 a
TS50	65.6 a
TS100	48.8 b
Water regime	
WR 1 - high	60.4 ns
WR 2 - medium	59.2 ns
WR 3 - low	56.4 ns

Mean separation within columns by Duncan's multiple range test ($p < 0.01$)

WILD STRAWBERRY

Substrate	Crown Ø (mm)	Plant height (cm)	Leaves (n.)	Fruit Chroma index	Fruit SSC (°Brix)	Fruit pH	Fruit TA
TS100	36.1 b	30.2 a	111.4 a	38.0 a	15.1 a	3.7 b	19.5 b
TS50	39.7 a	29.6 ab	110.9 a	38.3 ab	15.8 a	3.6 b	20.2 a
TS0	34.5 b	27.5 b	118.0 a	36.8 a	15.7 a	3.8 a	18.1 c

Legend: the same letter near each value indicates no significant difference for the parameters across substrate ($p<0.05$); SSC = Soluble Solids Content; TA = Titratable Acidity (mequiv NaOH/100 g FW)

Substrate	Plant yield (g)	Fruit FW (g) (10 fruits)	Fruit DW (g) (10 fruits)	Fruit lenght (mm)	Fruit diameter (mm)
TS100	33.7 a	6.9 b	1,0 b	16.7 a	10.5 b
TS50	41.4 a	6.9 b	1.0 ab	16.6 a	10.0 b
TS0	40.6 a	8.2 a	1.2 a	17.3 a	11.4 a

CONCLUSIONS

The remedied sediment proved to be a valid alternative to peat for wild strawberry production. Fruits obtained from plants cultivated on the different growing media displayed similar pomological characteristics. On the other hand, basil production was significantly influenced by the substrate, being total fresh weight and leaf area significantly higher in plants obtained on peat-based growing medium. Plants did not show any visible phytotoxic symptoms or damages.

Strawberry plants grown on TS50: soon after planting (A) and 4 months after planting (B)