LIFE AGRISED, LIFE17 ENV/IT/000269

"Use of dredged sediments for creating innovative growing media and technosols for plant nursery and soil rehabilitation"

Guideline

Use of co-composted sediments in soil reconstitution

Forewords

This booklet originated from the results of the reconstitution pedotechnique applied to dredging sediments and co-compost carried out during LIFE AGRISED, LIFE17 ENV/IT/000269 “Use of dredged sediments for creating innovative growing media and technosols for plant nursery and soil rehabilitation”.

These guidelines aim to describe how reconstitution can be used as an effective tool to create a fertile technosol, also applying the principles of Circular Economy, starting from dredging sediments and co-compost.

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The reconstitution in AGRISED

The reconstitution pedotechnique is based on the treatment of organic and non-organic matrices for producing Technosols. The technology applies a conceptual model based on the production of new soil aggregates with targeted environmental characters generated via a chemical–mechanical process that entails reusing residues of a specific origin.

The reconstitution is framed as a mechanical-chemical system which carries out the treatment of suitable materials, producing soils with good environmental and agronomic properties.

The working process, in short, begins with the mixing of different matrices - dosed on the basis of their environmental, chemico-physical and agronomic properties -, the mixture is then disintegrated, unstringed and spalled with mechanical forces to encase the organic matter into the mineral component. This phase is followed by the real reconstitution which consists in a mechanical compression of the disintegrated compound according to some technical parameters that affect the properties of the different matrices used. This treatment, depending on the characters of the matrices involved in the mixture, may require an additional phase of polycondensation which occurs during the disintegration by adding humic and fulvic acids.

Fig. 1 (NEWLIFE logo) graphically illustrates the main concept of reconstitution where the position of the organic matter in the reconstituted neo-aggregates is schematized, it is placed in the middle and covered by mineral component.

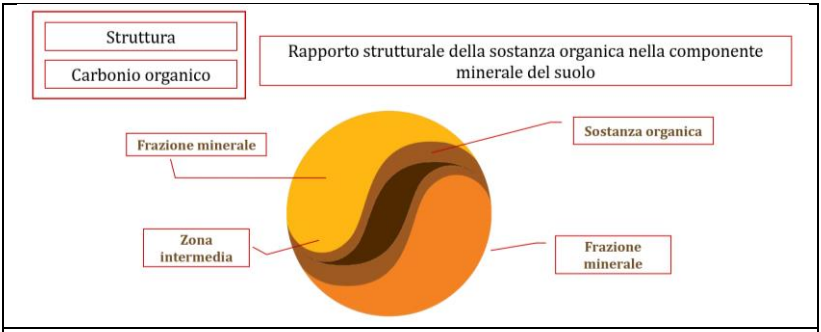


Figure 1 New Life logo, conceptual diagram of the reconstituted aggregate

From this innovative approach, there is the involvement in AGRISED project: the application of Ecosistemi technology for the conversion of dredged sediment, specifically coming from the Navicelli Canal, and co-composts into fertile soils to be used as cultivation substrates or for the restoration of degraded areas. This opportunity offers:

- *To make economically feasible to empty natural and artificial canals and irrigation, hydro-electric and drinking water basins*: the technology makes it possible to convert sediments accumulated over the years into a reusable material even in massive quantities by operating near the intervention sites with the much lower expenditure of economic resources.

- *To produce a technosol that can replace the use of non-renewable resources*: the increasing lack of soil to be used to restore landscape profiles, degraded soils and brownfield can be solved with the large amount of sediments which, now, do not find their suitable relocation except for disposal.

In AGRISED project the reconstituted soils, produced with dredge sediment and co-compost, were used to make experiments in soil columns and pots. The aim of the project was to demonstrated if reconstitution technology could be an effective instrument to recycle dredge sediment and co-compost to create a Technosol to be used as a growing media for plant nursery and soil rehabilitation.

The AGRISED Technolsols were analyzed and packed in 40 L columns for an experiment lasted 8 months. During the experiment the columns were regularly watered to induced water-dry cycles; leachate and interstitial water were sampled every 2 months and analyzed; soil moisture, electrical conductivity and temperature were monitored every 15 minutes using Hydra Probe. At the end of the experiment the columns were dismissed and the soil were sampled and analyzed.

The reconstituted soils were also used to make a trial in pots.

PEDOGÉNIA

The reconstitution system envisages a design phase before treatment which, through a calculation program designed and owned by Ecosistemi, PEDOGÉNIA, allows the dosage to improve the properties of the primary matrix (the main component, by quantity used or by project objective, involved in the treatment of reconstitution, it's represented by degraded soil and / or dredged sediments from dams, reservoirs and canals; in AGRISED project dredged sediment and co-composts) together with the most suitable matrices (secondary matrices: organic and/or mineral components, added to the primary matrix, they are waste materials from different production activities, Fig. 2).



Figure 2 Some secondary matrices

AGRISED dredged sediment, degraded soil and co-composts were analyzed and the analytical data were elaborated using PÉDOGENIA. All the analyses were made in Ecosistemi chemical (Fig. 6) and pedotechnic laboratories (Fig. 7).



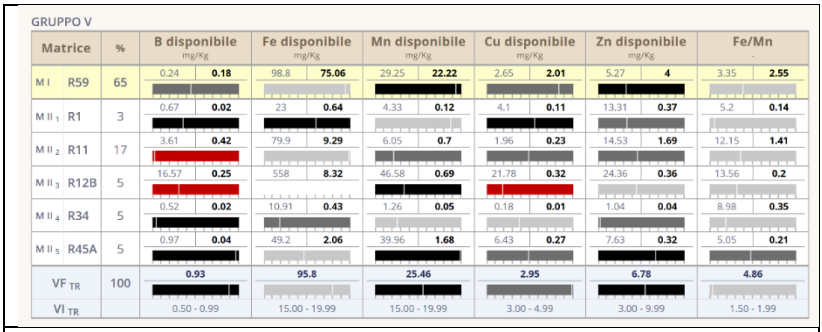
Figure Chemical laboratory



Figure 4 Pedotechnic laboratory

To the primary matrix characterization follow a research in PEDOGÉNIA archives of the secondary matrices. PEDOGÉNIA program (Fig. 5) archived historical environmental and agronomical data of hundreds of materials

well-suited. On the base of this archive PEDOGÉNIA allow to identify a series of secondary matrices, to be mixed with primary matrix, considering their chemico-physical composition on environmental basis - starting from the concentration of chemical parameters admitted to the legal limits (Column A of Legislative Decree 152/2006 Part Five) - and on agronomic basis.



GRUPPO V

Matrice	%	B disponibile mg/Kg		Fe disponibile mg/Kg		Mn disponibile mg/Kg		Cu disponibile mg/Kg		Zn disponibile mg/Kg		Fe/Mn -	
M I R59	65	0.24	**0.18**	98.8	**75.06**	29.25	**22.22**	2.65	**2.01**	5.27	**4**	3.35	**2.55**
M II 1 R1	3	0.67	**0.02**	23	**0.64**	4.33	**0.12**	4.1	**0.11**	13.31	**0.37**	5.2	**0.14**
M II 2 R11	17	3.61	**0.42**	79.9	**9.29**	6.05	**0.7**	1.96	**0.23**	14.53	**1.69**	12.15	**1.41**
M II 3 R12B	5	16.57	**0.25**	558	**8.32**	46.58	**0.69**	21.78	**0.32**	24.36	**0.36**	13.56	**0.2**
M II 4 R34	5	0.52	**0.02**	10.91	**0.43**	1.26	**0.05**	0.18	**0.01**	1.04	**0.04**	8.98	**0.35**
M II 5 R45A	5	0.97	**0.04**	49.2	**2.06**	39.96	**1.68**	6.43	**0.27**	7.63	**0.32**	5.05	**0.21**
VF TR	100	**0.93**		**95.8**		**25.46**		**2.95**		**6.78**		**4.86**	
VI TR		0.50 - 0.99		15.00 - 19.99		15.00 - 19.99		3.00 - 4.99		3.00 - 9.99		1.50 - 1.99	

Figure 5 One of the data processing pages in PEDOGÉNIA program

Further parameters, determined for the treatment planning, concern the determination of the technical (rheological) characters such as: liquid and plastic limits; resistance to penetration; fibrousness; fiber consistency; fibrous fraction; qualitative and quantitative observations of the fibers (Fig. 6 – 7); amorphous fraction.



Figure 6 Ecosistemi microscopy laboratory for the determination of the fibrous components

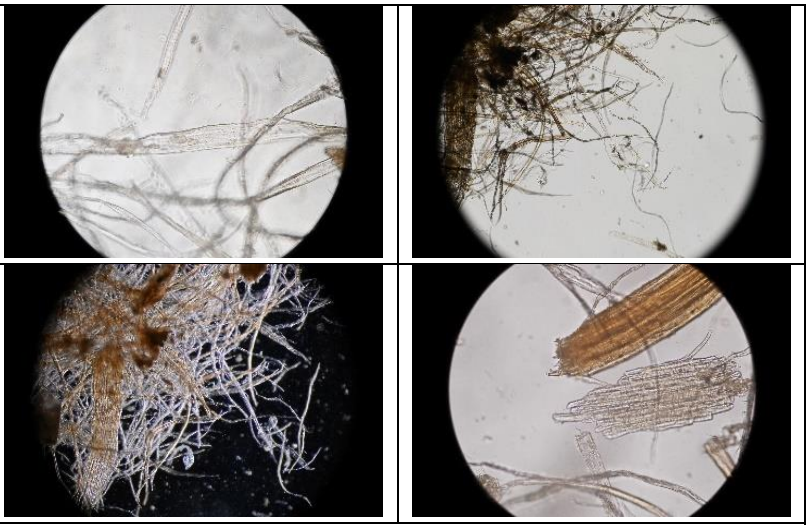


Figure 7 Fibrous components micro pictures 300X

After setting the matrices and the dosage, the reconstitution was carried out using a laboratory pilot implant (Fig. 8 - 9 - 10 – 11 – 12 – 13).



Figure 8 Pedotechnic laboratory with the soil columns system



Figura 9 Mixer



Fig. 10 Soil reconstitution treatment



Fig. 11 Tecnosol for analytical analysis



Figure 12: reconstitution laboratory plant



Figure 13: reconstituted soils

Two lines of reconstituted soil were produced: line a: primary matrices + degraded soil, line b: primary matrices + degraded soil + secondary matrices.

The non-reconstituted primary matrices, together with the 2 types of technosols were used to set up 18 soil columns (75 x 26 cm, V 40 L) (Fig. 14).

1. ***Soil columns with non-reconstituted primary matrices***
   - Degraded soil, 2 columns
   - Dredge sediment, 2 columns
   - Co-compost 1:1, 1 column
   - Co-compost 1:3, 1 column
   - Co-compost 3:1, 1 colum

2. ***Soil columns with primary matrices reconstituted***
   a. **Line a**
      - CR 1:1.a Co-compost 1:1 – degraded soil 1, 1 column
      - CR 1:3.a Co-compost 1:3 – degraded soil 1, 1 column
      - CR 3:1.a Co-compost 3:1 – degraded soil 1, 1 column

   b. **Line b**
      - DR dredge sediment – degraded soil – secondary matrices, 2 columns
      - CR 1:1.b Co-compost 1:1 – degraded soil – secondary matrices, 2 columns
      - CR 1:3. b Co-compost 1:3 - degraded soil – secondary matrices, 2 columns
      - CR 3:1. b Co-compost 3:1 – degraded soil – secondary matrices, 2 columns



Figure 14: soil columns

The aim of the column test was to monitor soil water content, temperature and electrical conductivity, leachate and interstitial water. Wet-dry cycles were followed during the test: one watering per month.

For these tests the columns were equipped with Hydra Probe (Fig. 15 – 16) (at 25 and 50 cm height) connected with 6 data loggers to create an autonomous long-term measurement series. Hydra Probe measure simultaneously soil water content, temperature and electrical conductivity; the measurements were set to be recorded every 15 minutes. Hydra Probe data were processed by calculating the monthly averages for each parameter.

The interstitial water was sample every 2 months using suction cups (Fig. 17) at 25 and 50 cm height. On interstitial water they were analyzed pH, electrical conductivity, iron, manganese, sodium, calcium, chlorides and nitrates.

The leachate water was sample every 2 months using a flask (Fig. 18 – 19 – 20). On leachate they were analyzed pH,

electrical conductivity, total N, nitrates, arsenic, cadmium, chromium, mercury, nickel, lead, copper and zinc.
At the end of the test, the soil was sampled at 25 (top) and 50 (bottom) cm height in the columns to evaluate possible variations on the way. These analytical results were compared with data on dredge sediment, co-composts and reconstituted soils before the test (Tables 1 – 2 – 3 – 4).

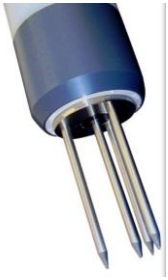


Figure 15: Hydra Probe



Figura 16 Data Logger



Figure 17: suction cup



Figura 18 Flask setting for sampling the leachate



Figura 19 Retention filter at the column base



Figura 20 Column conical bottom

Results

Chemico-physical analysis

Co-compost texture was silt loam, dredge sediment was sandy loam; the bulk density was 0.9 g cm^{-3} in co-compost 1:1 and 1:3, while 1.1 g cm^{-3} in co-compost 3:1 and 1.3 g cm^{-3} on dredge sediment. All reconstituted co-composts were sandy loam, reconstituted dredge sediment was loamy sand. Particle and bulk density increased after reconstitution. Porosity was reduced by reconstitution in co-compost 1:3 and increased in co-compost 3:1.

pH values indicate that co-composts were neutral while dredge sediment was slightly alkaline. The reconstitution didn't induce remarkable change in pH value.

Electrical conductivity was very high in dredge sediment describing it as saline soil. After reconstitution there was a reduction in EC value in comparison with original sample and within reconstituted soils it was low in line "b" in comparison with line "a".

Total $CaCO_3$ reduced after reconstitution; Active Limestone increased.

Total carbon decreased in reconstituted soils.

Organic carbon decreased in reconstituted co-compost while increased in reconstituted dredge sediment.

C/N showed the best increase in reconstituted dredge sediment.

Olsen P decreased in reconstituted co-composts except for co-compost 3:1a and b, in comparison with original sample.

Available iron and manganese decreased mainly in line "b". Fe/Mn decreased in reconstituted dredge sediment, while increased in reconstituted co-composts.

Available zinc and copper decreased in reconstituted soil.

Assimilable potassium decreased in all reconstituted soil except in reconstituted co-compost 3:1.
Assimilable magnesium decreased in all reconstituted soils.
Soluble boron decreased in all reconstituted soils.
Cation exchange capacity, exchangeable bases and exchangeable sodium percentage decreased in all reconstituted soils.
Mg/K increased in reconstituted dredge sediment and reconstituted co-compost 1:3; it decreased in reconstituted co-compost 3:1; in reconstituted co-compost 1:1 it didn't change.

			$CaCO_3$	Active Limestone	Tot C	Inorg. C	Org. C	O.M.	Tot N	C/N
			g kg^{-1} SS							
pre	**F**		78.6	7.5	12.56	9.4	3.5	6.01	0.51	7
post		T	118.6	10.5	25.09	14.2	8.5	14.7	0.94	9
		B	68.0	13.3	15.53	8.2	8.0	13.8	0.99	8
		T	93.6	15.6	14.69	11.2	6.4	11.0	0.68	9
		B	65.5	5.6	10.86	7.9	5.6	9.6	5.32	1
post	**D**	T	43.4	1.2	4.69	5.2	1.4	2.5	3.40	0
		B	41.8	2.1	4.79	5.0	1.3	2.2	2.04	1
		T	7.5	4.8	8.35	0.9	1.3	2.2	0.60	2
		B	39.2	9.9	5.11	4.7	1.1	2.0	0.33	3
pre	**DR**		64.1	20.1	15.38	7.7	25.5	44.0	0.75	34
post		T	68.3	31.0	52.13	8.2	15.0	25.9	3.21	5
		B	74.6	31.9	23.23	8.9	12.5	21.5	1.28	10
		T	54.0	28.0	26.60	6.5	12.3	21.2	1.66	7
		B	62.8	28.4	22.27	7.5	10.1	17.4	1.27	8
pre	**C 1:1**		70.2	15.3	51.47	8.4	52.2	90.1	3.54	15
post		T	83.4	30.9	47.83	10.0	36.3	62.5	3.52	10
		B	81.3	31.9	47.68	9.8	33.4	57.6	3.47	
pre	**CR 1:1.a**		62.4	11.5	27.75	7.5	17.5	30.1	2.98	6
post		T	50.5	19.6	29.36	6.1	15.8	27.3	2.06	8

		B	55.9	18.8	35.43	6.7	13.3	22.9	2.38	6
pre	**CR 1:1.b**		62.6	25.5	24.93	7.5	25.8	44.5	1.38	19
post		T	66.4	27.1	32.00	8.0	17.3	29.9	2.10	8
		B	60.5	27.1	32.30	7.3	15.6	26.9	2.19	7
		T	66.0	29.7	28.35	7.9	25.8	44.4	1.81	14
		B	54.1	25.3	25.13	6.5	23.1	39.8	1.59	
pre	**C 1:3**		63.1	14.1	75.90	7.6	76.4	131.7	6.16	12
post		T	73.4	26.8	39.98	8.8	27.1	46.8	3.18	9
		B	73.0	28.1	43.17	8.8	24.2	41.7	3.13	8
pre	**CR 1:3.a**		54.5	16.0	20.89	6.5	16.4	28.2	1.68	10
post		T	50.2	18.8	17.07	6.0	13.3	22.9	1.23	11
		B	43.5	19.9	28.37	5.2	10.6	18.3	1.84	6
pre	**CR 1:3.b**		87.8	51.4	31.00	10.5	23.8	41.0	1.73	14
post		T	69.0	22.4	27.57	8.3	13.9	23.9	1.79	8
		B	64.5	25.0	26.09	7.7	10.6	18.3	1.62	7
		T	70.5	30.1	7.39	8.5	17.5	30.2	1.2	14
		B	66.7	29.5	17.91	8.0	13.9	24.0	1.1	12
pre	**C 3:1**		88.5	19.1	38.68	10.6	36.2	62.4	2.60	14
post		T	78.0	29.3	71.05	9.4	52.7	90.9	6.14	9
		B	79.2	26.3	71.26	9.5	49.1	84.6	6.07	8
pre	**CR 3:1.a**		58.5	34.1	39.39	7.0	30.6	52.8	3.02	10

post		T	46.1	21.5	44.77	5.5	22.2	38.3	3.51	6
		B	48.3	19.4	39.15	5.8	17.9	30.8	3.01	
pre	**CR 3:1.b**		99.1	80.3	38.01	11.9	31.7	54.6	2.37	13
post		T	88.3	28.2	44.87	10.6	36.1	62.2	3.49	10
		B	86.5	33.8	40.88	10.4	34.2	58.9	2.79	12
		T	70.5	24.5	34.09	8.5	19.2	33.0	2.44	8
		B	69.2	26.1	36.52	8.3	18.1	31.3	2.52	7

Table 1: chemical data: comparison (T: top, B: bottom)

			pH	EC	Tot S	Olsen P	P_2O_5
				dS m^{-1}	g kg^{-1} SS	mg kg^{-1}SS	
pre	**F**		8.2	16.6	2.7	49	112
post		T	7.9	9.5	2.51	54	123
		B		9.3	2.94	54	125
		T	8.1	7.9	2.43	62	142
		B		7.7	5.10	54	123
post	**D**	T	8.9	0.8	2.86	1	2
		B	9.1	0.7	1.84	2	4
		T	8.2	0.8	1.65	19	44
		B	8.7	0.6	1.04	2	4
pre	**DR**		8.1	4.3	1.5	30	68
post		T	8.0	2.9	2.23	40	94
		B	7.4	2.7	1.46	37	85
		T		2.6	1.55	33	75

		B	7.5	2.5	1.44	31	70
pre	**C 1:1**		7.6	4.4	2.9	101	232
post		T	7.3	8.3	2.21	145	331
		B		7.6	2.62	138	315
pre	**CR 1:1.a**		8.0	3.5	6.0	79	180
post		T	7.5	3.6	1.09	84	193
		B	7.4	3.5	1.99	85	194
pre	**CR 1:1.b**		8.0	2.5	1.2	68	155
post		T	7.4	2.2	1.51	82	189
		B		2.1	1.40	86	196
		T		2.0	1.11	67	153
		B	7.3	1.9	1.37		
pre	**C 1:3**		7.7	5.7	3.6	142	324
post		T	7.6	8.5	3.76	131	301
		B	7.2		3.32	116	265
pre	**CR 1:3.a**		8.0	3.2	3.50	84	191
post		T	7.8	3.4	1.38	34	79
		B	7.6	3.2	1.24	36	82
pre	**CR 1:3.b**		7.5	3.4	1.5	76	173
post		T	7.3	1.8	0.97		
		B		1.7	3.39	71	162
		T		2.5	0.9	67	154
		B	7.4	2.2	1.1	74	169
pre	**C 3:1**		7.7	3.7	1.7	81	186
post		T	7.1	8.5	3.47	179	410
		B	7.2	8.4	2.97	187	428

pre			8.3	4.0	2.9	85	195
post	**CR 3:1.a**	T	7.3	4.7	1.31	107	245
		B		4.5	1.28	105	241
pre			7.2	3.6	1.4	90	206
post	**CR 3:1.b**	T	7.0	5.8	1.33	118	269
		B	7.3	5.6	1.07	110	252
		T	7.2	2.9	0.97	73	167
		B	7.3	2.6	0.94	66	151

Table 2: chemical data: comparison (T: top, B: bottom)

			CEC	Mg^{2+}	K^{+}	Na^{+}	Ca^{2+}	GSB	SAR	ESP	Mg/K	K_2O
			$cmol_{(+)}\ kg^{-1}$					%	meq L^{-1}			mg kg^{-1} SS
pre			7.6	2.64	0.72	5.73	1.52	100	10.8	75.7	3.7	339
post	**F**	T	9.8	7.54	7.91	2.00	25.94	441	0.5	20.3	1.0	3730
		B	8.2	7.52	8.09	2.07	25.72	530		25.3	0.9	3813
		T	13.8	1.69	1.06	2.40	7.22	90	1.1	17.4	1.6	498
		B	9.3	1.78	1.05	2.36	7.65	139		25.6	1.7	493
post	**D**	T	8.7	0.15	0.07	0.52	1.58	26	0.6	5.9	2.3	31
		B	6.5	0.15	0.06	0.48	1.60	35	0.5	7.4	2.5	30
		T	5.1	0.17		0.02	2.65	57	0	0.5	3.1	26
		B	4.0	0.11	0.04		1.74	47			2.7	19
pre			19.5	1.68	0.32	2.64	14.88	100	0.9	13.5	5.3	149
post	**DR**	T	8.2	0.64	0.18	0.25	6.34	91	0.1	3.1	3.6	83
		B	13.2	0.63		0.27	6.19	55		2.1	3.5	84
		T	12.2	0.64	0.21	0.31	6.31	61	0.2	2.5	3.0	100
		B	8.1	0.66	0.23	0.43	6.53	97		5.2	2.8	113

pre	**C 1:1**		32.9	5.17	3.84	0.46	23.44	100	0.2	1.4	1.3	1810
post		T	32.8	7.89	7.10	1.44	26.44	131	0.3	4.4	1.1	3346
		B	34.3	8.13	8.25	1.87	27.27	133	0.4	5.5	1.0	3890
pre	**CR 1:1.a**		22.5	2.82	1.20	0.20	18.31	100	0.1	0.9	2.3	567
post		T	16.0	2.14	1.40	0.22	10.09	87		1.4	1.5	661
		B	15.3	2.16	1.37	0.19	10.20	91		1.3	1.6	646
pre	**CR 1:1.b**		21.7	2.05	0.84	0.23	18.60	100		1.1	2.4	397
post		T	12.7	1.47	0.98	0.19	9.83	98		1.5		461
		B	16.3	1.43	1.08	0.38	9.47	76	0.2	2.3	1.3	508
		T	13.0	0.96	0.92	0.16	5.68	59	0.1	1.2	1.1	431
		B	11.0	0.91	0.87	0.20	5.40	67		1.8	1.0	411
pre	**C 1:3**		40.7	3.82	5.48	0.43	30.94	100	0.1	1.1	0.7	2581
post		T	31.9	4.82	3.24	1.20	17.45	84	0.4	3.8	1.5	1527
		B	28.3	4.77	3.33	1.29	17.19	94		4.6	1.4	1571
pre	**CR 1:3.a**		22.3	3.08	0.81	0.19	18.19	100	0.1	0.9	3.8	383
post		T	8.4	0.82	0.32	0.24	7.16	102		2.9	2.5	152
		B	12.2	0.83	0.29	0.11	7.28	70		0.9	2.9	135

pre			22.2	2.33	0.99	0.24	18.69	100		1.1	2.4	465
post	**CR 1:3.b**	T	20.6	1.25	0.59	0.08	9.50	55	0.0	0.4	2.1	277
		B	14.0	1.25	0.66	0.22	9.47	83	0.1	1.5	1.9	313
		T	15.0	1.04	0.58	0.11	8.22	66		0.7	1.8	272
		B	16.2	1.10	0.60	0.09	8.68	65	0.0	0.5		282
pre	**C 3:1**		30.3	6.59	2.11	0.39	21.16	100	0.1	1.3	3.1	996
post		T	44.0	5.09	5.77	0.61	20.59	73	0.2	1.4	0.9	2718
		B	47.9	4.51	6.05	0.79	18.32	62	0.2	1.7	0.7	2853
pre	**CR 3:1.a**		28.3	2.79	2.55	0.22	22.71	100	0.1	0.8	1.1	1199
post		T	21.0	2.07	2.15	0.35	9.83	69		1.7	1.0	1013
		B	22.0	2.09	1.96	0.20	9.97	65		0.9	1.1	921
pre	**CR 3:1.b**		26.5	2.44	2.41	0.30	21.34	100		1.1	1.0	1138
post		T	25.9	2.21	2.16	0.55	13.06	70	0.2	2.1		1020
		B	23.2	2.18	2.04	0.49	12.90	76			1.1	961
		T	16.6	1.49	1.40	0.51	10.13	81		3.1		660
		B	19.2	1.51	1.44	0.55	10.20	71		2.9	1.0	677

Table 3: chemical data: comparison (T: top, B: bottom)

			Avail. Fe	Avail. Mn	Fe/Mn	Avail. Zn	Avail. Cu	Assim. K	Assim. Mg.	Sol. Bo
			mg kg^{-1} SS			mg kg^{-1} SS				
pre			91.2	8.3	11	27.7	7.1	130.0	205.1	1.24
post	**F**	T	78.4	4.3	18	7.6	9.2	56.4	112.5	0.45
		B	71.3	4.7	15	9.8	10.2	109.7	178.4	0.61
		T	72.9	4.4	17	8.0	9.3	54.3	103.7	0.05
		B	82.2	4.8		7.7	9.8	95.6	128.9	
post	**D**	T	8.5	5.2	2	0.5	0.2	0.5	13.6	
		B	7.5	3.5		0.0	0.1	4.4	10.1	
		T	11.5	3.6	3	21.5	0.7	5.7	14.0	0.03
		B	6.5	4.0	2	0.6	0.1	2.9	8.3	0.02
pre			22.8	13.0		5.0	2.50	89.2	99.2	0.88
post	**DR**	T	27.2	3.2	9	4.0	2.9	26.6	50.6	0.53
		B	27.3	3.3	8	3.9	2.9	26.5	52.0	0.50
		T	19.7	2.9	7	2.0	1.6	19.9	45.3	0.47
		B	19.5	2.8		2.1	1.2	20.2	46.8	0.41

pre	**C 1:1**		267.7	78.0	3	24.0	16.6	810.8	373.3	2.91
post		T	178.3	22.1	8	29.8	13.3	553.3	310.7	1.24
		B	154.3	22.8	7	70.8	12.7	564.3	291.3	1.24
pre	**CR 1:1.a**		136.2	20.2		11.20	6.89	339.6	175.2	1.76
post		T	96.2	9.0	11	21.8	6.1	163.4	114.3	1.01
		B	100.6	9.5		22.7	6.3	161.9	128.6	1.07
pre	**CR 1:1.b**		90.6	25.4	4	8.32	4.88	251.3	123.4	1.43
post		T	88.7	11.0	8	25.9	5.7	141.0	91.6	0.73
		B	91.5	11.3		26.8	5.8	144.9	94.5	0.74
		T	45.6	5.6		4.2	2.6	64.3	49.0	0.75
		B	59.2	7.4		5.1	3.5	85.0	63.2	0.76
pre	**C 1:3**		238.0	59.2	4	27.6	10.5	1741	370.2	3.44
post		T	144.2	13.1	11	25.8	14.5	266.5	280.9	1.50
		B	141.4	12.8		25.4	14.3	257.6	275.1	1.56
pre	**CR 1:3.a**		122.7	13.9	9	11.0	7.24	204	172.0	1.42
post		T	24.6	2.8		2.4	1.9	22.5	46.9	1.09
		B	23.5	3.1	8	2.8	1.9	22.9	58.4	1.04

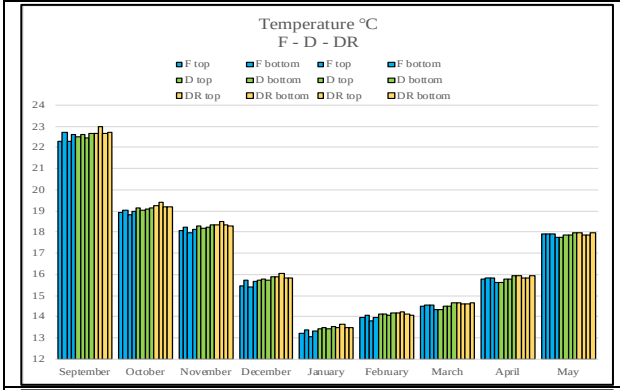
pre			117.1	19.7		9.17	6.72	175	149.8	1.36
post	**CR 1:3.b**	T	41.2	6.4	6	4.9	3.4	61.9	63.1	0.66
		B	44.1	7.1		4.8	3.3	52.1	62.3	0.63
		T	54.9	7.5	7	16.5	4.5	66.0	67.5	0.43
		B	53.6	7.3	7	16.0	4.2	64.6	65.5	0.39
pre			179.7	40.2	4	11.5	12.4	319.4	301.2	1.83
post	**C 3:1**	T	166.7	25.8	6	40.7	8.8	1039.4	261.2	0.04
		B	173.7	23.6	7	37.1	9.1	1005.6	253.8	
pre			141.3	26.4	5	13.2	5.2	633.7	165.6	2.40
post	**CR 3:1.a**	T	69.8	9.8	7	12.2	3.9	360.8	110.3	1.43
		B	71.7	10.7		13.1	4.0	353.3	113.0	1.42
pre			132.1	34.6	4	9.2	5.1	412.6	138.0	2.44
post	**CR 3:1.b**	T	86.3	12.8	7	12.1	4.4	318.9	141.1	0.90
		B	80.3	11.9		11.4	4.2	295.3	131.5	0.95
		T	53.5	8.1		10.8	2.9	167.3	84.2	0.72
		B	53.2	8.0		10.7	2.8	166.7	83.7	0.71

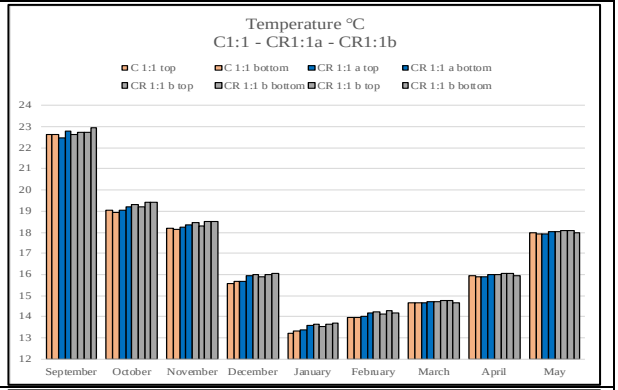
Table 4: chemical data: comparison (T: top, B: bottom)

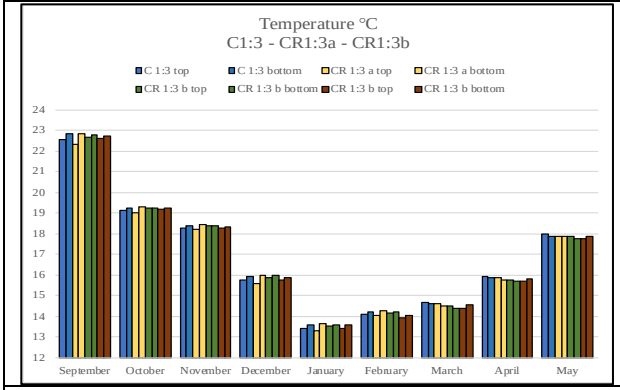
Hydra Probe data

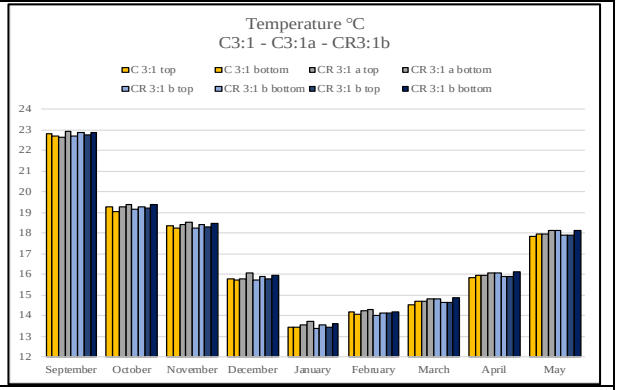
Temperature

Hydra Probe data concerning temperature described for all the columns a trend related with room temperature (Hystograms 1).





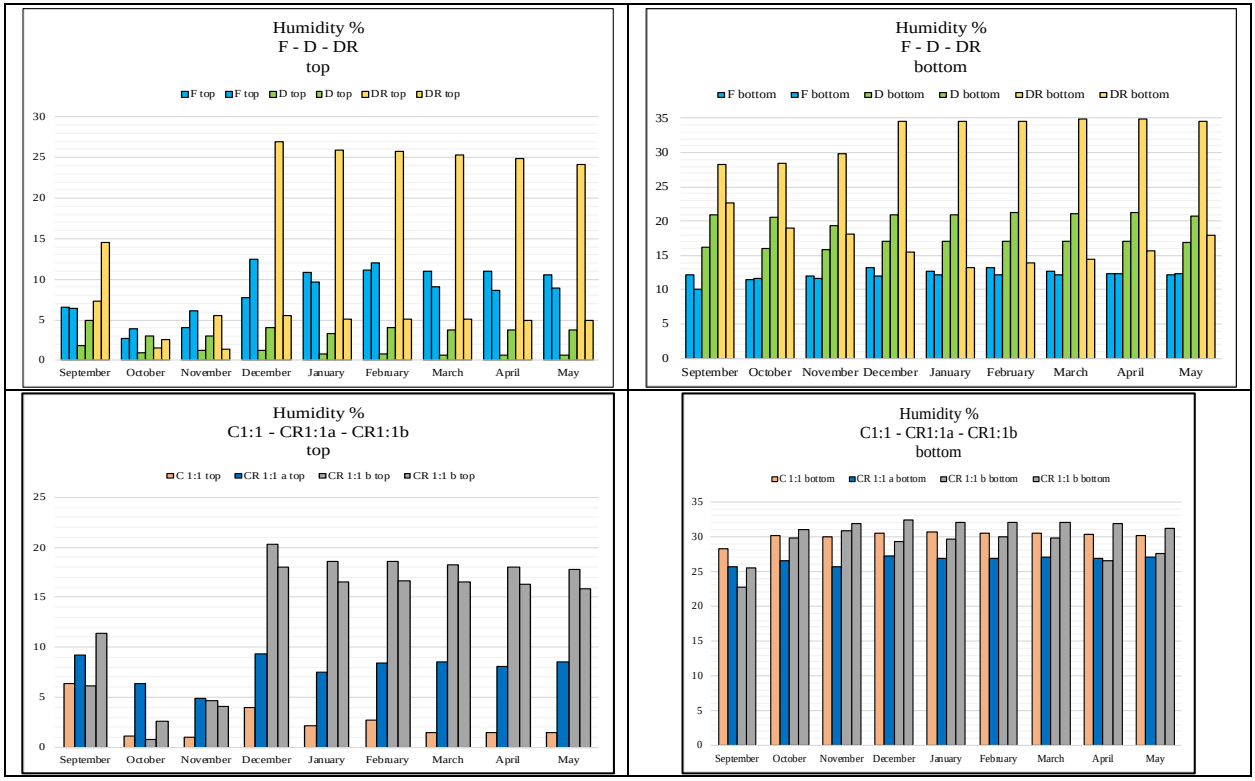


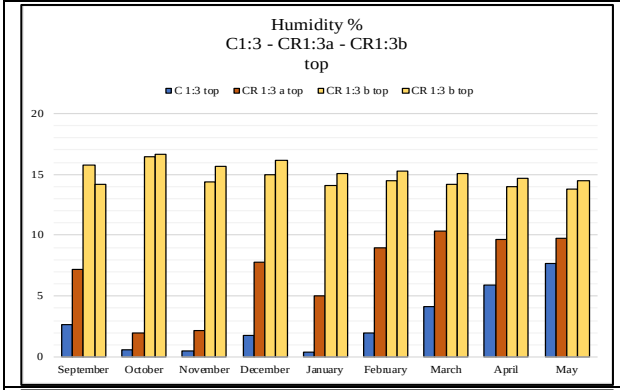


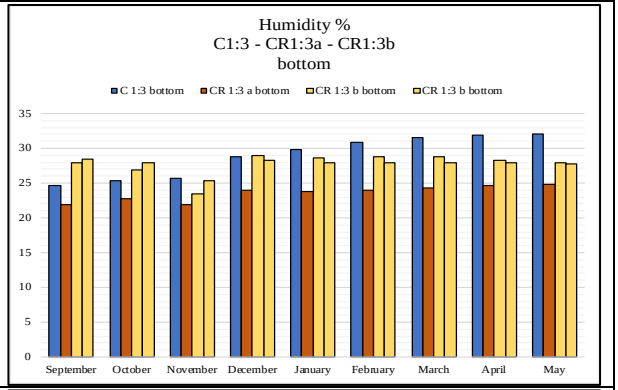
Histograms 1: temperature data

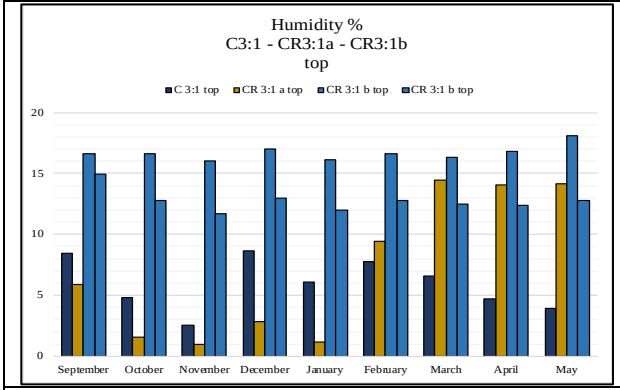
Humidity

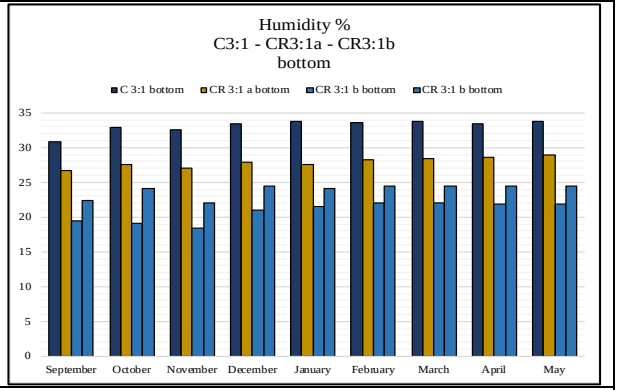
Humidity in dredge sediment ad reconstituted dredge sediment showed high value in reconstituted soil (Hystograms 2). The same was for co-compost 1:1 line. Co-compost 1:3 and 3:1 showed only in the top of the column high humidity in comparison with reconstituted soil.


Humidity %
F - D - DR
top
F top
F top
D top
D top
DR top
DR top
30
25
20
15
10
5
0
September
October
November
December
January
February
March
April
May
Humidity %
F - D - DR
bottom
F bottom
F bottom
D bottom
D bottom
DR bottom
DR bottom
35
30
25
20
15
10
5
0
September
October
November
December
January
February
March
April
May
Humidity %
C1:1 - CR1:1a - CR1:1b
top
C 1:1 top
CR 1:1 a top
CR 1:1 b top
CR 1:1 b top
25
20
15
10
5
0
September
October
November
December
January
February
March
April
May
Humidity %
C1:1 - CR1:1a - CR1:1b
bottom
C 1:1 bottom
CR 1:1 a bottom
CR 1:1 b bottom
CR 1:1 b bottom
35
30
25
20
15
10
5
0
September
October
November
December
January
February
March
April
May





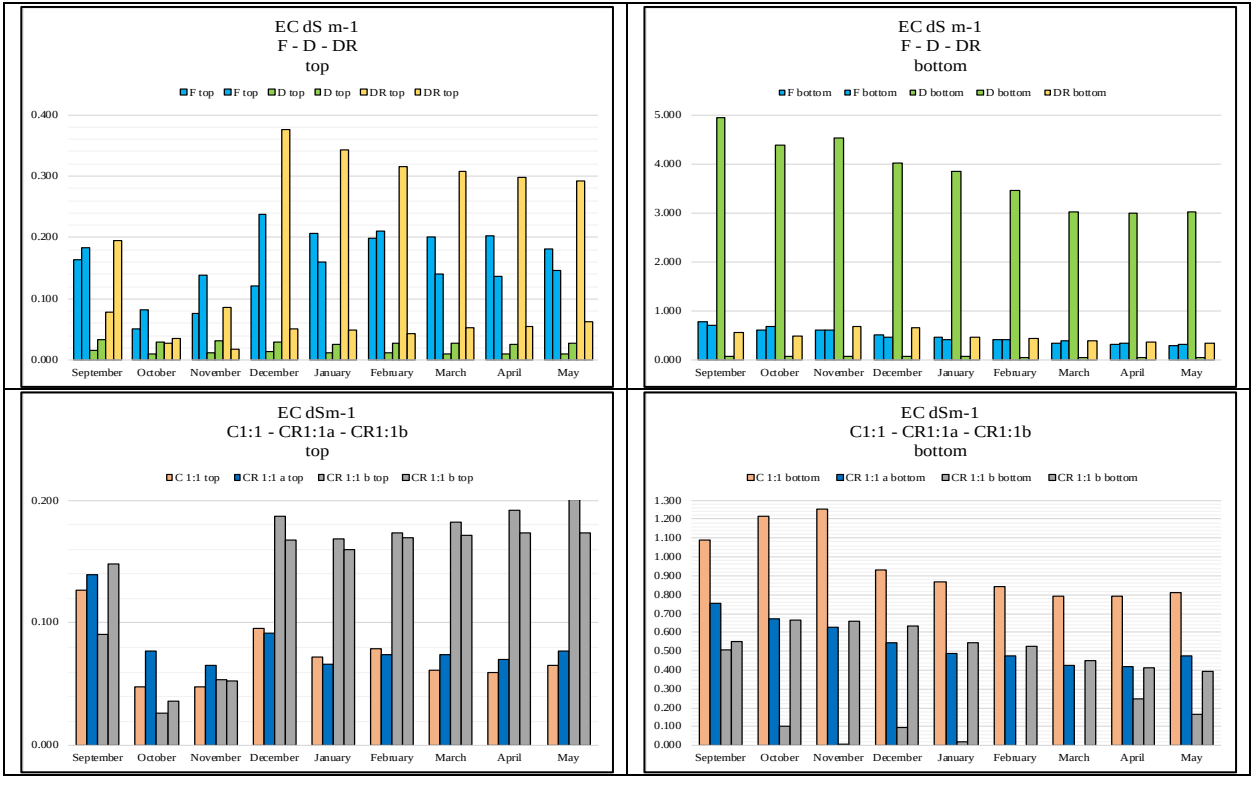


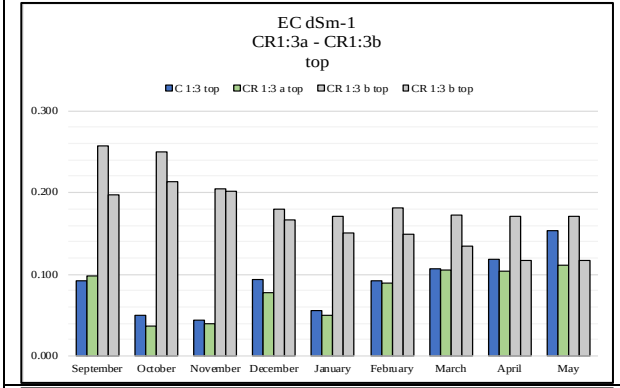


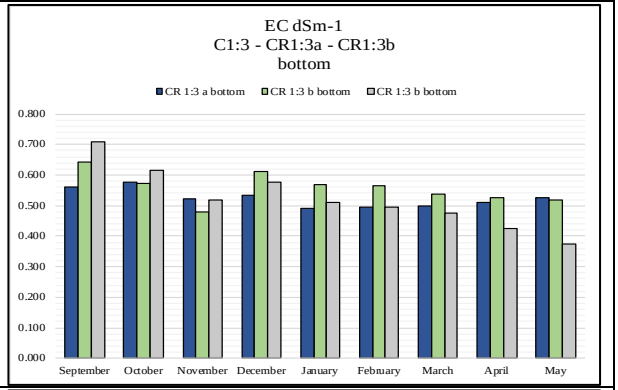
Hystograms 2: humidity data

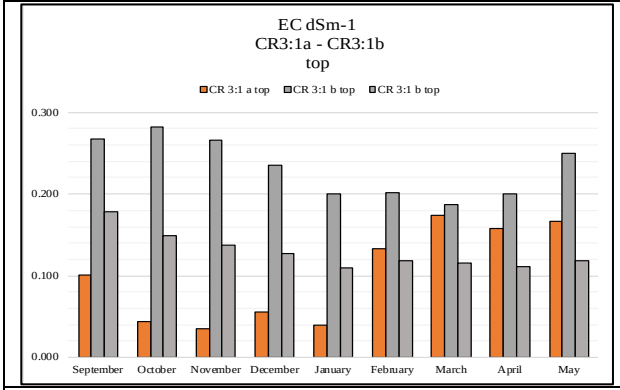
Electrical conductivity

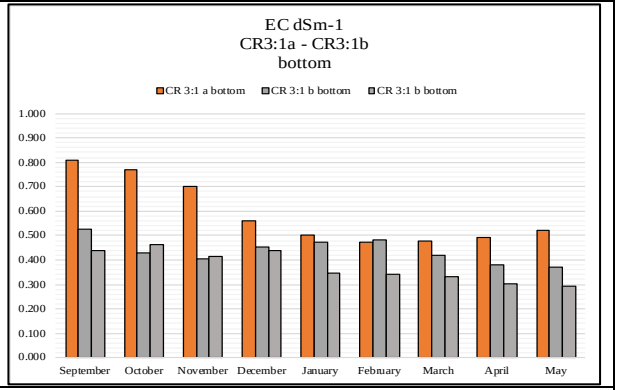
Electrical conductivity data were always high in the bottom of the columns (Hystograms 3). In particular in the top reconstituted soils showed high values in comparison with co-compost and dredge sediment, the contrary was true considering the bottom values.


EC dS m-1
F - D - DR
top
F top
F top
D top
D top
DR top
DR top
0.400
0.300
0.200
0.100
0.000
September
October
November
December
January
February
March
April
May
EC dS m-1
F - D - DR
bottom
F bottom
F bottom
D bottom
D bottom
DR bottom
5.000
4.000
3.000
2.000
1.000
0.000
September
October
November
December
January
February
March
April
May
EC dSm-1
C1:1 - CR1:1a - CR1:1b
top
C 1:1 top
CR 1:1 a top
CR 1:1 b top
CR 1:1 b top
0.200
0.100
0.000
September
October
November
December
January
February
March
April
May
EC dSm-1
C1:1 - CR1:1a - CR1:1b
bottom
C 1:1 bottom
CR 1:1 a bottom
CR 1:1 b bottom
CR 1:1 b bottom
1.300
1.200
1.100
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
September
October
November
December
January
February
March
April
May









Hystograms 3: Electrical Conductivity data

Leachate water comparison

Leachate water electrical conductivity since September to May decreased especially in reconstituted dredge sediment (Table 6).

	EC				
	dS m^{-1}				
	September	November	January	March	May
F	28.1	16.4	9.4	7.4	5.0
F	32.7	17.3	13.9	8.9	6.8
D	0.7	0.3	0.4	0.3	0.3
D	1.0	0.8	0.7	0.6	0.5
DR	6.4	5.7	2.7	1.8	1.3
DR	5.5	4.3	3.0	1.9	1.3
C 1:1	5.1	4.1	3.6	2.4	1.2
CR 1:1.a	5.5		4.1	3.3	2.8
CR 1:1.b	5.0	4.0	3.9	2.0	1.4
CR 1:1.b	4.6	4.3	2.6	1.9	1.2
C 1:3	5.2	4.9	4.8	3.9	3.3
CR 1:3.a	5.4	4.3	4.2	2.9	2.7
CR 1:3.b	5.3	5.3	3.4		2.2
CR 1:3.b	4.3	4.5	3.3	3.5	2.3
C 3:1	6.4	4.9	4.0	2.7	1.5
CR 3:1.a	6.0	4.2	4.1	3.4	2.9
CR 3:1.b	5.4	4.0	3.4	3.0	2.1
CR 3:1.b	5.4	4.5	2.4	2.0	2.0

Table 6: leachate water: Electrical Conductivity

Total nitrogen in water increased in reconstituted dredge sediment especially in November; in co-compost 1:3 total nitrogen was higher in reconstituted than in original sample, in other months it was lower. The same was for nitrates (Table 7).

	Tot N				
	mg L^{-1}				
	September	November	January	March	May
F	21	14	10	9	10
F	15	17	21	25	11
D	13	3		2	4
D	16	13	7	6	9
DR	15	157	36	15	5
DR	9	129	17	10	11
C 1:1	67	109	122	67	41
CR 1:1.a	139	95	83	73	70
CR 1:1.b	7	182	63	19	14
CR 1:1.b	5	165	7		9
C 1:3	224	257	377	205	498
CR 1:3.a	310	207	238	153	127
CR 1:3.b	340	199	121	145	147
CR 1:3.b	310	245	116	194	121
C 3:1	90	56	72	77	48
CR 3:1.a	65	31	30	34	27
CR 3:1.b	30	119	65	74	73
CR 3:1.b	27	97	81	128	147

Table 7: leachate water: total Nitrogen

Interstitial water comparison

Interstitial water electrical conductivity and nitrates confirmed the trend observed in leachate water (Tables 8 – 9).

		EC				
		dS m^{-1}				
		September	November	January	March	May
F	T	18.6	16.5	8.3	6.8	6.3
	B	25.3	18.6	9.8	8.5	8.9
F	T	20.5	18.2	8.5	6.6	6.9
	B	28.8	19.6	15.4	8.2	9.3
D	T	0.7	0.6	0.5	0.4	0.4
	B	1.0	0.5	0.5	0.5	0.5
D	T	0.9	0.6	0.6	0.6	0.4
	B	1.0	0.4	0.3	0.4	0.4
DR	T	6.2	5.8	3.4	3.0	2.5
	B	6.0	6.0	4.6	4.1	2.0
DR	T	6.3	5.6	3.0	3.1	2.3
	B	6.0	5.8	5.0	3.9	2.3
C 1:1	T	4.8	4.6	2.8	2.5	1.6
	B	4.8	4.0	3.6	2.0	1.5
CR 1:1.a	T	6.0	5.5	5.5	3.8	3.5
	B	3.4	3.8	4.2	4.0	3.1
CR 1:1.b	T	5.8	4.2	3.9	2.4	2.0
	B	5.6	4.0	4.2	2.5	2.4
CR 1:1.b	T	5.9	4.9	4.0	2.4	1.9
	B	5.4	3.7	3.8	2.2	2.2

C 1:3	T	5.7	5.1	5.2	4.4	2.9
	B	4.0	4.9	4.5	4.2	3.8
CR 1:3.a	T	5.0	4.6	3.9	3.1	3.0
	B	4.8	5.1	4.2	3.6	3.4
CR 1:3.b	T	5.8	5.0	4.2	3.5	3.2
	B	5.2	4.9	4.5	4.0	2.4
CR 1:3.b	T	5.6	4.8	4.0	3.8	3.8
	B	5.6	5.3	4.8	3.4	3.1
C 3:1	T	7.1	7.8	5.3	3.8	2.7
	B	7.9	7.2	6.8	4.1	2.9
CR 3:1.a	T	7.2	7.8	5.5	4.2	3.2
	B	8.5	7.5	6.1	5.8	3.8
CR 3:1.b	T	4.9	5.1	4.8	3.9	3.0
	B	5.2	5.2	5.0	3.7	2.8
CR 3:1.b	T	5.4	5.4	4.5	3.1	2.5
	B	5.6	4.9	3.8	2.9	2.4

Table 8: interstitial water: Electrical Conductivity (T: top, B: bottom)

		NO_3^-				
		mg L^{-1}				
		September	November	January	March	May
F	T	0.7	28	52	54	53
	B	7.6	31	60	50	46
F	T	10	60	30	46	44
	B	21	73	34	73	67
D	T	14	11	10	8	8
	B	19	14	12	10	9
D	T	12	14	10	9	9
	B	22	28	28	22	18
DR	T	0.6	305	207	53	32
	B	0.8	396	250	82	17
DR	T	1.1	301	199	67	26
	B	0.9	388	266	80	72
C 1:1	T	198	186	102	99	67
	B	225	378	329	285	124
CR 1:1.a	T	389	412	365	305	315
	B	457	425	383	326	300
CR 1:1.b	T	153	831	454	231	115
	B	184	925	382	162	94
CR 1:1.b	T	85	827	356	110	98
	B	104	864	264	132	60
C 1:3	T	726	905	895	746	215
	B	544	877	900	833	362
CR 1:3.a	T	754	908	804	612	515

	B	841	886	825	720	585
CR 1:3.b	T	945	824	602	510	363
	B	879	855	659	606	422
CR 1:3.b	T	866	859	597	587	405
	B	894	906	601	675	388
C 3:1	T	74	262	250	208	184
	B	83	307	298	234	176
CR 3:1.a	T	189	201	157	109	76
	B	207	194	128	86	52
CR 3:1.b	T	174	488	253	220	287
	B	98	427	226	241	270
CR 3:1.b	T	110	383	288	324	322
	B	132	412	210	307	358
	B	132	412	210	307	358

Table 9: interstitial water: Nitrates (T: top, B: bottom)

Conclusions

The analyzes data confirmed and corroborate the results obtained over the years on reconstituted soils: the reconstitution improvs all the characters linked to soil fertility.

In general, it can be said that reconstitution improves the chemical-physical characters of the primary and secondary matrices used: they are worth considering:

- increase in organic carbon content
- C/N describing an increase in humification processes
- increase in water retention capacity and improvement of all physical properties related to it.

According to AGRISED data it can be said that the reconstitution pedotechnology is able to create a fertile Technosol for plant nursery starting from co-compost and dredge sediment.