CONTINUATION OF THE STUDY ON THE USE IN ORGANIC FARMING OF QUALITY COMPOST IN THE SAN MARINO REPUBLIC

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1 PRESENTATION

This work summarizes the results obtained in the territory of the San Marino Republic on the management of organic waste from the collection to the use of recovered things according to the basic principle of the circular economy.

The door-to-door collection of the organic fraction and the fraction obtained from the maintenance of the gardens and the consequent treatment in a modular plant with a regular patent has made possible to obtain a fertilizer of great quality.

In addition to improving the collection service of biodegradable waste, the research has provided a method to use the product obtained and the benefits it brings to the environment and in the improvement of agricultural production on some plants obtained with organic farming practices.

The comparison between production obtained with the use of compost (mixed composted soil improver) and without compost and a series of analyses on the soil and on the goods obtained with a economic analysis, highlight the importance of a practice similar to that described here for proper waste management.

2 COLLECTION TYPOLOGY AND TREATMENT/PRODUCTION PLANT

Door-to-door collection for each user has been organized for all domestic users and for catering activities.

To make it easier to transfer, biodegradable bags have been delivered.

The transport to the treatment plant was carried out with appropriate transportation avoiding any dispersion during the journey.

The canteen waste was then unloaded on a special box to be mixed in a suitable chopped mixer with wood waste to obtain a substrate with suitable C/N e humidity.

The substrate from the shredder was then discharged directly into the biocell for a stay of about 30 days.

The biocell is equipped with a biofilter, ventilation apparatus and a mechanical and process monitoring and control system even remotely.

At the end of the process the material was screened and sent directly to the place of use. During this period, analyses were carried out in the waste and finished compost.

3 ANALYSIS OF THE BENEFITS INDUCED BY THE USE OF COMPOST

The research has highlighted the properties of the compost produced to maintain optimal soil fertility and make sure to grow some plant species without any addition of fertilizers and other chemicals. Considering the second year of the trial, a comparison was made between the data collected in 2022 with those of 2023.

Analyses were carried out on treated and untreated soil and on compost on which ecotoxicity was assessed in particular by biological tests.

After the analytical investigations, the preparation of the same soil used in 2022 followed and consequently the spreading of the soil.

On the basis of the chemical-physical characteristics of the soil and on the basis of the nutritional requirements of the plant species used (vegetables), the quantity for m^2 to be distributed was determined.

The calculation based on the law of the minimum suggested to make 30 kg of compost for unit area. A normal manure spreader was used for distribution.

4 FIELD TESTS AND RESULTS

The research activity, before the planting of plant species with the biological passport, has ascertained through analytical procedures the possibility by law to use compost in organic farming.

During the growth of the plants, the different vegetative phases were detected and then for the second year the chemical analyzes on the main characterizing active ingredients, namely vitamins, carotenes and all those compounds that make these food products effective for our health.

To verify the effectiveness of the compost, also in this case, the analyzes of 2022 were compared with those of 2023.

In addition to the analysis of the different vegetables, the research involved the analytical characterization of the soil with compost and without compost.

In addition to the content of the main mineral macronutrients, in particular those characteristics that define the fertility of a soil have been evaluated, namely: a) microbial activity b) water retention c) SAR value d) contained in humic acids, fulvic acids.

5 RESULTS AND DISCUSSION

Two important considerations underlie the results obtained with the experimentation carried out for the second year in San Marino in relation to the correct management of the organic matter contained in domestic waste.

The production of compost and above all its actual use has made it possible to improve the characteristics of the soil: better water retention capacity, increase in the activity of the soil microbiota, increase in organic matter and humified substances with consequent improvement in soil structure.

All these characteristics are highlighted through the comparison of the soil with and without compost in 2023.

As far as the benefits in agricultural production are concerned, in addition to an increase in the quantity of goods produced, the analyses have highlighted, even if minimally, the increase in the nutritional and healthy properties of the species used for the test. The results on some active ingredients especially regarding the protein content and phthalates indicated in the certificates analysis allow us to confirm what has been said with good reliability. Similar values are observed on other active ingredients for which research will pay greater attention at an analytical level.

6 CONCLUSIONS

The investigation represented in this poster, in addition to assuming a scientific role, acquires an importance regarding the circular economy because it represents the closure of the circle between waste management and real recovery and natural insertion of recycled material.

The correct treatment through the composting of the organic fraction and the consequent use of the good produced in economic and environmental advantage allow to respect the concept Waste generation - service management - recovery - use - recycling of a natural asset - improvement of production - protection of resources.

On this basis, the Republic of San Marino through the Secretariat of State for the Territory and Environment has promoted this research to demonstrate the importance of proper management of the organic fraction of waste that represents a considerable amount in the entire territory of the Republic.

Out of a population of 36,000 inhabitants and a waste production equal to c.a. 16.000 tons for year of which 40 - 45% is represented by the biodegradable fraction.

Soil and compost analysis 2023		Compost	No Compost
PARAMETER DESCRIPTION	U.M.	VALUE	VALUE
Fine Silt	%	40,00	71,70
Coarse Silt	%	37,10	12,90
Fine Sand	%	16,40	13,80
Coarse Sand	%	1,40	0,70
Clay	mg/kg	5,10	0,90
Total Limestone	%	21,00	25,00
Cation Exchange capacity	meq/100g	28,50	20,70
Assimilable Phosphorus	mg/kg	238,20	86,80
PH degree of realisation	U. pH	8,69	8,51
Electrical conductivity	µS/cm	230,20	260,00
Residue at 105°C	mg/kg	89,30	88,3
Skeleton between 2 cm and 2 mm	%	< 1	< 1
Humidity	%	10,70	11,7
Organic carbon	%	0,20	0,20
Ashes	mg/kg	86,70	84,90
Total nitrogen	mg/kg	4.190,00	4.010,00
Calcium	mg/kg	52.640,00	57.830,00
Iron	mg/kg	12.400,00	14.000,00
Magnesium	mg/kg	4.772,00	5.166,00
Manganese	UFC/g	410,00	460,00
Potassium	UFC/g	2.230,00	1.767,00
Copper	UFC/g	23,50	20,50
Sodium	UFC/g	1.457,00	940,80
Zinc	%	50,00	43,80
SAR (Sodio Asorbent ratio)	meq/100g	0,20	0,10
Yeast and hyphomycetes counter	UFC/g	1.900,00	4.900,00
Microbial load count	UFC/g	> 10^8	1 x 10^7
Aerobic bacteria count	UFC/g	2,3 x 10^6	3,6 x 10^5
Anaerobic bacteria count	UFC/g	9.800,00	5.200,00
Microaerofili count	UFC/g	3 x 10^5	2,9 x 10^5

Nutritional values per 100 g	LACTUGA S.		LYCOPERSICUM E.	
	NO Compost	Compost	NO Compost	Compost
Medium weight (g)	360,00	540,00	95,00	165,00
Production per square metre kg/m^2	2,10	4,10	5,90	9,50
Water content %	88,74	94,10	90,88	91,11
Energy (kJ/100g)	87,86	86,80	19,80	18,80
Carbohydrates (g/100g)	3,10	1,30	6,10	5,40
Sugars (g/100g)	0,90	0,76	4,20	4,50
Protein (g/100g)	1,79	2,37	1,10	1,29
Fat (g/100g)	0,39	0,23	0,05	0,04
Fiber (g)	2,70	2,20	3,60	3,80
Iron (mg/kg)	230,00	140,00	4,90	4,00
Calcium (mg/kg)	2.100,00	1.400,00	66,00	68,00
Sodium (mg/kg)	1,30	6,90	18,00	28,00
Potassium (mg/kg)	4.900,00	6.000,00	2.700,00	3.100,00
Phosphorus (mg/kg)	310,00	418,00	290,00	260,00
Magnesium (mg/kg)	370,00	330,00	130,00	130,00
Vitamin A (IU/kg)	< 2000	< 2000	< 1000	< 1000
Vitamin D (IU/kg)	< 2000	< 2000	< 2000	< 2000
Vitamin E, α - tocopherol (mg/kg)	13,60	9,00	< 1,00	1,20
Vitamin E (mg/kg)	12,40	8,20	1,48	1,50
Vitamin B1 (mg/kg)	0,05	0,05	0,04	0,04
Vitamin B2 (mg/kg)	0,18	0,21	0,18	0,18
Vitamin B3 (mg/kg)	0,70	0,78	0,62	0,59
Vitamin B6 (mg/kg)	n.r	n.r	n.r.	n.r.
Folate (µg/100g)	51,80	58,90	7,40	7,30
Vitamin C (mg/kg)	9,20	10,00	33,00	10,00
Vitamin B12 (µg)	n.r.	n.r	n.r.	n.r.

Nutritional values per 100 g	CHICORIUM I.		PHASEOLUS V.	
	NO Compost	Compost	NO Compost	Compost
Medium weight (g)	215,00	365,00	16,00	21,00
Production per square metre kg/m^2	2,80	3,40	0,42	0,75
Water content %	89,80	86,90	89,50	87,18
Energy (kJ/100g)	12,20	11,90	134,00	137,00
Carbohydrates (g/100g)	3,80	3,80	2,40	1,90
Sugars (g/100g)	2,10	2,10	1,60	2,15
Protein (g/100g)	2,15	3,06	2,10	2,18
Fat (g/100g)	0,40	0,40	0,20	0,21
Fiber (g)	2,80	3,60	2,90	7,20
Iron (mg/kg)	69,00	33,00	2,00	37,00
Calcium (mg/kg)	2.000,00	730,00	37,00	1200,00
Sodium (mg/kg)	69,00	82,00	6,00	17,00
Potassium (mg/kg)	9.800,00	7.900,00	211,00	4400,00
Phosphorus (mg/kg)	450,00	580,00	380,00	410,00
Magnesium (mg/kg)	1.600,00	910,00	250,00	350,00
Vitamin A (IU/kg)	< 2000	< 2000	< 1000	< 1000
Vitamin D (IU/kg)	< 2000	< 2000	< 2000	< 2000
Vitamin E, α - tocopherol (mg/kg)	n.r.	n.r.	2,50	2,70
Vitamin E (mg/kg)	n.r.	n.r.	14,40	14,90
Vitamin B1 (mg/kg)	n.r.	n.r.	0,08	0,10
Vitamin B2 (mg/kg)	n.r.	n.r.	0,11	0,12
Vitamin B3 (mg/kg)	n.r.	n.r.	0,75	0,75
Vitamin B6 (mg/kg)	n.r	n.r.	0,10	0,15
Folate (µg/100g)	154,00	111,00	37,00	49,80
Vitamin C (mg/kg)	n.r.	n.r.	12,10	12,80
Vitamin B12 (µg)	n.r.	n.r.	n.r	n.r.

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