Organic wastes as alternative to inorganic fertilizers in crop cultivation

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Introduction

Almond and pistachio N, P and K requirements can be satisfied by adding organic wastes (OW). The use of OW as alternative to commercial chemical fertilizers not only results in an economic benefit to the small-scale farmer but it also reduces pollution due to reduced nutrient run-off, and N leaching. OW provide organic matter macronutrients (N, P and K) and also micronutrients which can contribute significantly to higher crop yields. With trees, as is the case of almond and pistachio, it is better to fertilize smaller doses more frequently. This, increases percentage of fertilizer uptake while reducing the risk of nutrient leaching. Following this principle, the use of OW as alternative to inorganic fertilizers is very convenient since they slowly release significant amounts of N and P. In addition, OW improve soil physical and microbiological properties, and furthermore, reduce soil borne diseases without the use of chemical control.

Objective

The aim of this work was to evaluate the effect of two OW on crop yield and soil quality in comparison with the use of inorganic fertilization. Barley and ryegrass were used as test plants but obtained results can be extended to almond and pistachio tree cultivation or any other crop.

Experimental design and Results

EXPERIMENTAL DESING

2 Soils

Cieza — Sand: 18.3%, Silt: 64.7%, Clay: 17.1%

San Javier — Sand: 14.1%, Silt: 46.1, Clay: 38.8%

+ 2 OW

R7: Compost of goat and sheep manure

R21: Compost of alperujo + goat manure + vegetal debris

+ Ammonium Nitrate

Left 1 month to grow

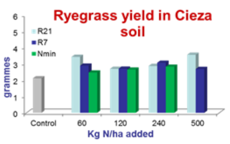
Barley and Ryegrass

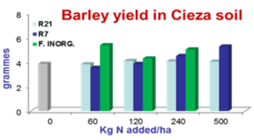
Soil analysis → Physical and chemical parameters

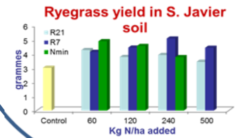
Plant yield → Fresh and dry weight

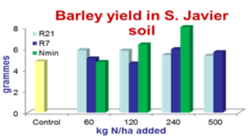
RESULTS

CROP YIELDS









OW increased crop yields with respect to the control at all the assayed rates, and led to similar ryegrass yields and slightly lower barley yields than inorganically fertilized soils, indicating that the use of OW can be a suitable alternative to inorganic fertilizers. Both OW enriched soil in available K, Mg, Mn, S and NH_4^+

EFFECTS ON SOIL NUTRITIONAL STATE

San Javier soil

	Al	Fe	Ca	B	K	Mg	Mn	Na	S	P
Control	1.11	0.68	54	1.54	14.1	27.27	0.17	243	118	<0.1
R7-1	0.89	0.50	72	1.46	24.2	37.11	0.23	285	150	<0.1
R7-2	0.61	0.32	76	1.36	34.9	39.30	0.24	267	159	<0.1
R7-3	0.49	0.28	107	1.42	52.5	54.35	0.33	289	220	<0.1
R7-4	0.45	0.23	157	1.44	119.2	76.99	0.45	313	314	<0.1
R21-1	0.68	0.49	52	1.41	14.9	25.31	0.21	281	135	<0.1
R21-2	0.85	0.50	60	1.41	24.0	31.54	0.20	273	131	<0.1
R21-3	1.12	0.65	51	1.36	34.5	28.62	0.18	256	109	<0.1
R21-4	0.86	0.59	73	1.23	53.1	40.16	0.25	282	127	<0.1

Cieza soil

	Al	Fe	Ca	B	K	Mg	Mn	Na	S	P
Control	7.22	4.42	66.73	0.52	24.21	27.66	0.20	32.18	7	1.16
R7-1	8.17	4.76	66	0.35	34.82	28.29	0.21	33.24	24	1.12
R7-2	6.86	4.03	85	0.34	57.50	34.96	0.25	40.46	55	1.18
R7-3	2.86	1.76	95	0.35	84.45	38.60	0.26	44.67	93	1.14
R7-4	1.81	1.02	137	0.38	171.86	54.20	0.36	56.24	190	1.15
R21-1	10.06	5.82	71	0.33	30.72	29.22	0.23	32.48	9	1.31
R21-2	10.60	6.22	66	0.34	39.26	29.14	0.23	34.75	9	1.40
R21-3	14.27	8.01	67	0.41	61.96	31.25	0.26	41.44	12	1.80
R21-4	30.57	17.10	66	0.49	116.21	34.22	0.32	57.91	19	2.44

San Javier soil

Ryegrass	mg $N-NH_4$/kg	C oxi %	mg NO_3^-/kg
Control	8.751	0.230	11.22
R7-1	9.221	0.328	11.40
R7-2	9.408	0.360	11.38
R7-3	9.413	0.347	11.15
R7-4	9.689	0.469	11.24
R21-1	8.960	0.294	12.10
R21-2	9.094	0.363	11.42
R21-3	10.289	0.297	11.88
R21-4	10.753	0.427	11.50
Barley			
Cont	8.651	0.205	11.26
R7-1	8.547	0.233	11.81
R7-2	8.854	0.492	11.93
R7-3	9.352	0.325	10.66
R7-4	9.849	0.446	11.05
R21-1	8.627	0.271	11.00
R21-2	8.506	0.268	11.05
R21-3	8.994	0.241	10.78
R21-4	9.731	0.314	10.55

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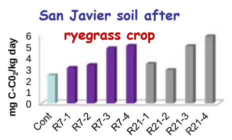
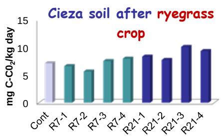
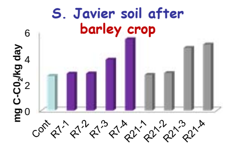
OW had a stimulant effect on microbial growth and activity, OW treated soils showing higher values of microbial biomass C and basal respiration than control soils after harvesting

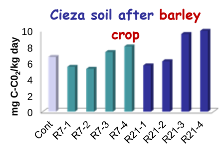
SOIL MICROBIOLOGICAL PROPERTIES

Basal Respiration

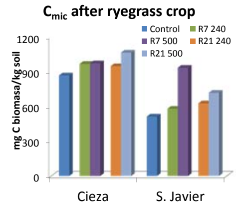


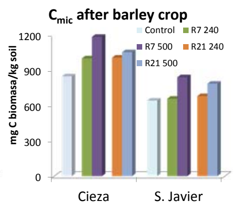






Microbial Biomass carbon (C_{mic})





CONCLUSION

Results showed that the application of OW to land as fertilizers not only provides essential nutrients to plants but also improves soil quality

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