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EFFECT OF RHAMNOLIPID JBR-425 ON THE DEVELOPMENT OF *BRASSICA JUNCEA* IN SOILS OF URBAN GARDENS OF SEVILLA (SPAIN)

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The current need to recover soils contaminated with potentially toxic metals to lessen their impact on the environment and on the food chain, leads different methods are being developed for their extraction. There is an additional concern when contamination occurs in urban farm soil. Phytoextraction can be enhanced by applying biodegradable biosurfactants, promoting the bioavailability of contaminants and their subsequent uptake by the plant. This technique is called assisted or induced phytoextraction. This work aims to evaluate the extraction of heavy metals from contaminated soils from an urban orchard in the town of Sevilla using Brassica juncea plants, as well as to estimate the improvement that the application of a biodegradable biosurfactant (Ramnolipid JBR-425) implies. For this, a greenhouse trial was carried out with two soils from an urban park and an agricultural one in which Brassica juncea was grown. A solution of Ramnolipid JBR-425 with a concentration of 1000 mg kg-1 was added to half of the pots to evaluate its effect on the development of the plants (number of leaves, plant height). The data collected showed a negative effect produced both by soil contamination and by the presence of rhamnolipid. The soil used in the experiment, as well as the plants, were collected for further analysis. Plant samples were divided into aerial part, root and fruit, to determine the amounts of heavy metals in the soil and extracted in the aerial part. The determination of heavy metals in soil was carried out by ICP-OES after AEDT extraction. Likewise, parameters such as electrical conductivity and pH were also measured. For the extraction of the metals extracted by the plants, acid digestion of the plant samples was performed and then they were measured using ICP-OES. The plants treated with rhamnolipid showed less development both in plant height and in the number of leaves; likewise, the biomass production capacity was reduced. These factors may be due to the toxic effect of rhamnolipid, as well as the effect of Potentially Toxic Elements. Although the plants with rhamnolipid application had higher concentrations of heavy metals in their tissues, since there was a notable decrease in biomass, they did not extract as much as the plants without treatment.

Effect of rhamnolipid JBR-425 on the development of *Brassica juncea* in soils of urban gardens of Sevilla (Spain)

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INTRODUCTION

The current need to recover soils contaminated with potentially toxic metals (PTEs) to lessen their impact on the environment and on the food chain, leads different methods are being developed for their extraction. There is an additional concern when contamination occurs in urban farm soil. Phytoextraction can be enhanced by applying biodegradable biosurfactants, promoting the bioavailability of contaminants and their subsequent uptake by the plant. This technique is called assisted or induced phytoextraction.

The added compound must be environmentally harmless, and not cause leaching of the contaminant toward lower soil horizons.

OBJECTIVE

This work aims to evaluate the extraction of heavy metals from contaminated soils from an urban orchard in the town of Sevilla using *Brassica juncea* plants, as well as to estimate the improvement that the application of a biodegradable biosurfactant Rhamnolipid JBR-425 (RL) implies.

METHODS

A greenhouse trial was carried out with two soils from an urban park (S1 and S2) and an agricultural one (S3) (Table 1). 500 ml pots (11 x 7 x 7 cm^3) were prepared in which *Brassica juncea* was grown (Figure 1-A). When the plants had five true leaves, one plant was left per pot. A solution of Ramnolipid JBR-425 (RL), equimolar commercial mixture of 2 naturally occurring rhamnoolipids (Figure 2), with a concentration of 1000 mg kg^{-1} was added to half of the pots to evaluate its effect on the development of the plants (number of leaves, plant height) (Figure 1-B). The soil used in the experiment, as well as the plants, were collected for further analysis. Plant samples were divided into aerial part, root and fruit, to determine the amounts of heavy metals in the soil and extracted in the aerial part. The determination of heavy metals in soil was carried out by ICP-OES after AEDT (0,05 M at pH 7) extraction. Likewise, parameters such as electrical conductivity and pH were also measured. For the extraction of the metals extracted by the plants, acid digestion of the plant samples was performed and then they were measured using ICP-OES.

MATERIALS

Tabla 1 – Características de los suelos

	S1	S2	S3
pH	7,35	7,75	7,60
Organic matter (%)	6,04	8,00	1,10
Carbonate (%)	14,0	16.2	19,0
Sand (%)	52,3	52,3	1,6
Silt (%)	25,0	25,0	28.3
Clay (%)	22,5	22,5	70,1

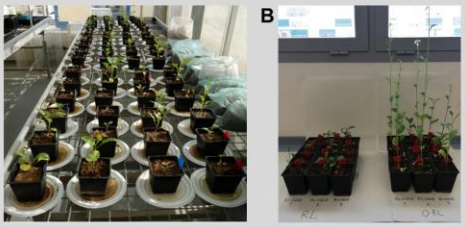
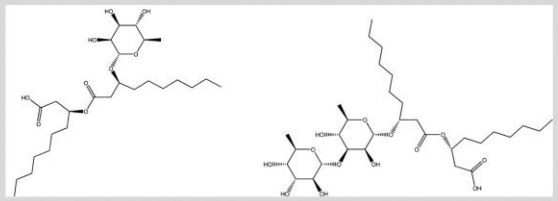


Fig.1. *Brassica juncea* plants, in a randomized complete block design (RCBD), roller table, 4 m^2 **(A); Plants growing in S1 and S1+RL (B)**



α-L-Rhamnopyranosyl-β-hydroxydecanoyl-β-hydroxydecanoate

2-O-α-L-Rhamnopyranosyl-α-L-rhamnopyranosyl-β-hydroxydecanoyl-β-hydroxydecanoate

Fig. 2. Rhamnolípids components from JBR-425 added to soil

RESULTS AND DISCUSSION

The data collected from crop evolution and relative growth rate (RGR) showed a negative effect produced both by soil contamination and by the presence of rhamnolipid (Figure 3).

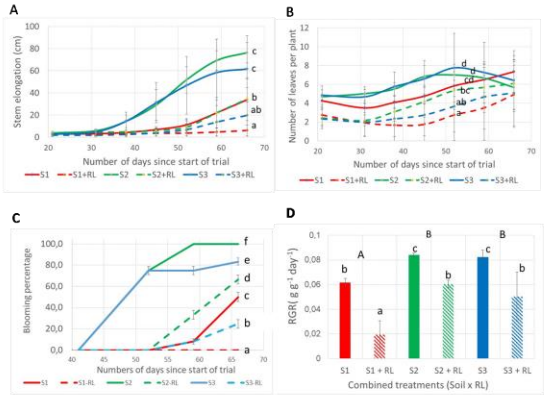


Fig. 3. Evolution of stem elongation (N=12) (A) , number of leaves per plant (N=12) (B), and blooming percentage (N=12) (C) . Relative Growth Rate (RGR) in each combined treatment (N=3) (D). (ANOVA one-way repeated measures of combined trealments and Tukey test (p<0,05)

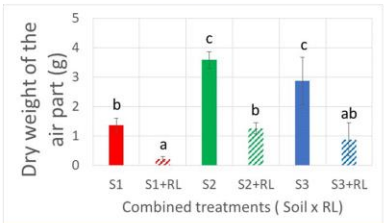


Fig. 4. Dry weigh of the air part at the end of the trial in each combined treatment (N=3). (ANOVA one-way, Tukey test (p<0,05)

The plants treated with rhamnolipid showed less development both in plant height and in the number of leaves; likewise, the biomass production capacity was reduced. These factors may be due to the toxic effect of rhamnolipid, as well as the effect of Potentially Toxic Elements. Although the plants with rhamnolipid application had higher concentrations of heavy metals in their tissues, since there was a notable decrease in biomass, they did not extract as much as the plants without treatment.

Table 2 – Concentration of EPTs in soil determined by RX Fluorescence

	Cu (mg kg^{-1})	Zn (mg kg^{-1})	Pb (mg kg^{-1})
S1	206,30	191,69	375,39
S2	90,98	125,05	158,00
S3	37,05	88,39	28,80

Table 3: Average concentrations of EPTs extracted from soil with EDTA 0,5M (pH 7) and extracted in aereal part by acid digestion measures using ICP-OES (N= 3). ANOVA one-way, Tukey test (p<0,05)

	Cu (mg kg^{-1})		Zn (mg kg^{-1})		Pb (mg kg^{-1})	
	soil	plant	soil	plant	soil	plant
S1	93,3 **c**	12,6 **b**	21,8 **bc**	47,9 **bc**	141,5 **c**	1,0
S1+RL	99,9 **d**	33,1 **c**	23,9 **c**	88,4 **d**	148,3 **d**	0,9
S2	35,7 **b**	5,3 **a**	18,4 **b**	34,0 **ab**	51,6 **b**	0,2
S2+RL	37,3 **b**	6,7 **a**	20,8 **bc**	52,6 **c**	53,6 **b**	3,7
S3	6,4 **a**	5,0 **a**	2,1 **a**	26,6 **a**	4,8 **a**	0,6
S3+RL	6,5 **a**	7,3 **a**	2,2 **a**	55,2 **c**	5,1 **a**	0,5

Table 4: Average amount of metal extracted by plants µg kg^{-1} of soil (N=3)

	Cu (µg kg^{-1})	Zn (µg kg^{-1})
S1	8,82	33,53
S1+RL	3,31	8,84
S2	9,54	61,20
S2+RL	4,19	32,88
S3	7,00	37,24
S3+RL	3,29	24,84

CONCLUSIONS

1. The plants treated with rhamnolipid showed less development both in plant height and in the number of leaves; likewise, the biomass production capacity was reduced

2. Although the plants with rhamnolipid application had higher concentrations of heavy metals in their tissues, since there was a notable decrease in biomass, they did not extract as much as the plants without treatment

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