Molecular identification and functional diversity of microorganisms isolated from the rhizosphere of plants grown in a suppressive soil substrate

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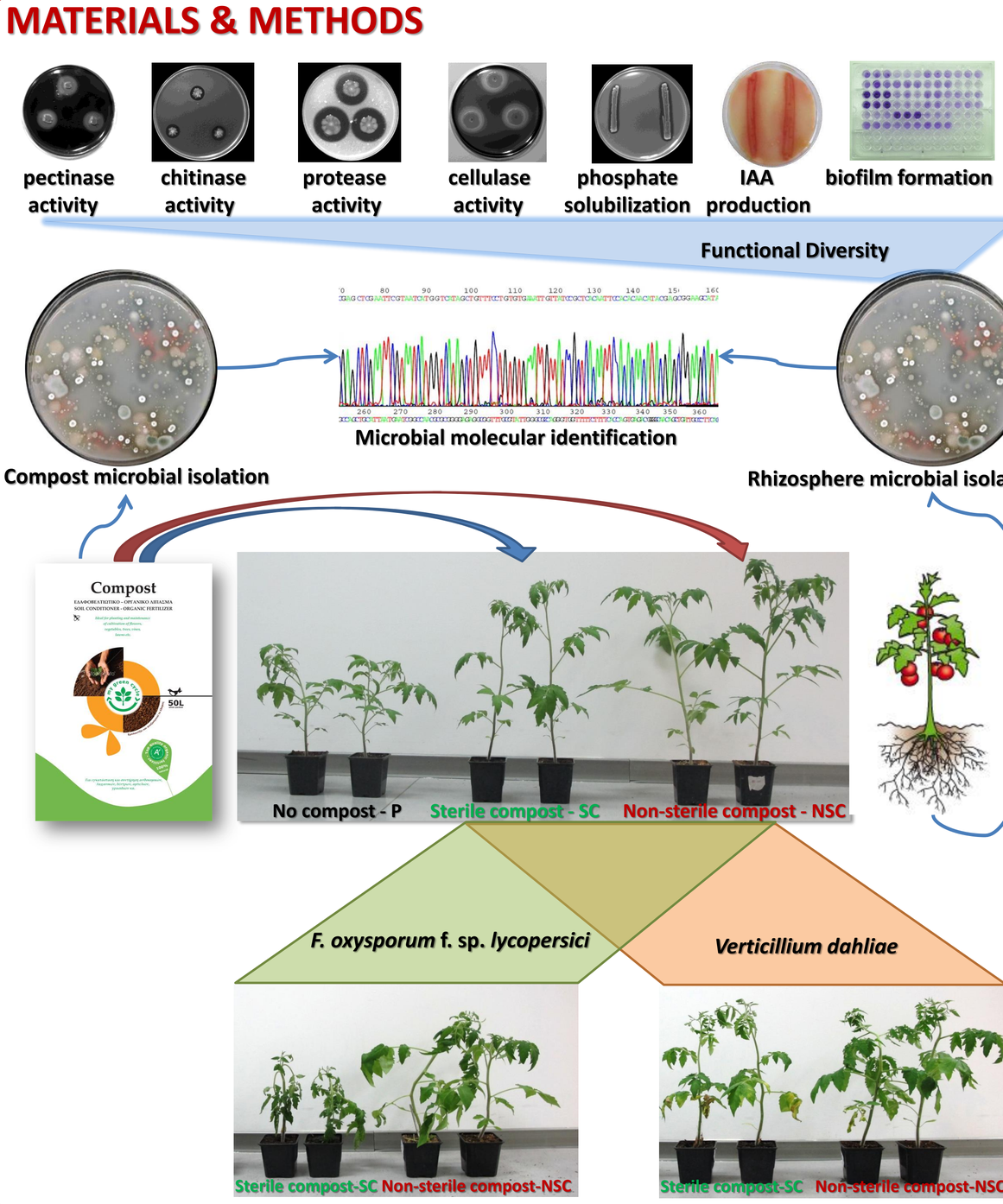
GOALS

(a) Evaluate the ability of a compost to improve plant growth of tomato plants,

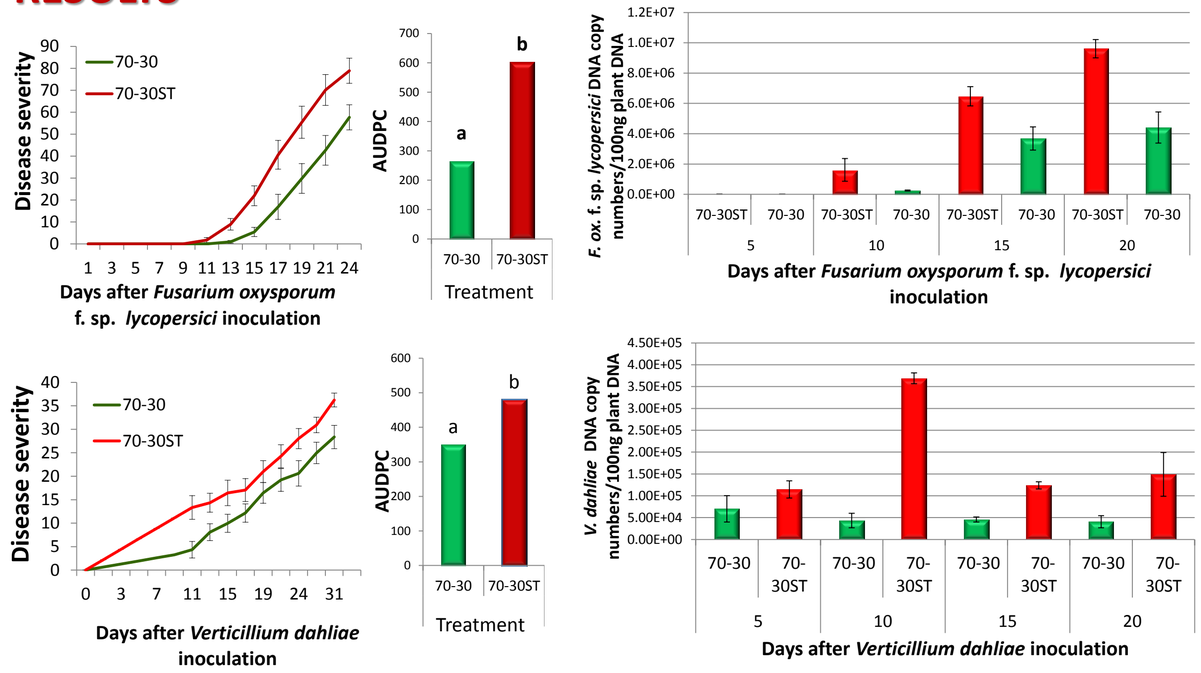
(b) Assess the suppressive effects of the compost against *Fusarium oxysporum* f. sp. *lycopersici* and *Verticillium dahliae* on tomato plants and

(c) Investigate the role of the microorganisms of the rhizosphere.

MATERIALS & METHODS



RESULTS

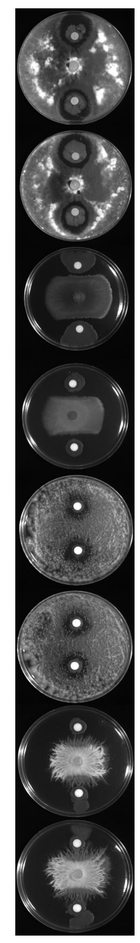


Pathogenicity experiments of tomato plants with the fungal wilt pathogens *Fusarium oxysporum* f. sp. *lycopersici* and *Verticillium dahliae* revealed the suppressive properties of the compost and the crucial role of the microorganisms of the compost.

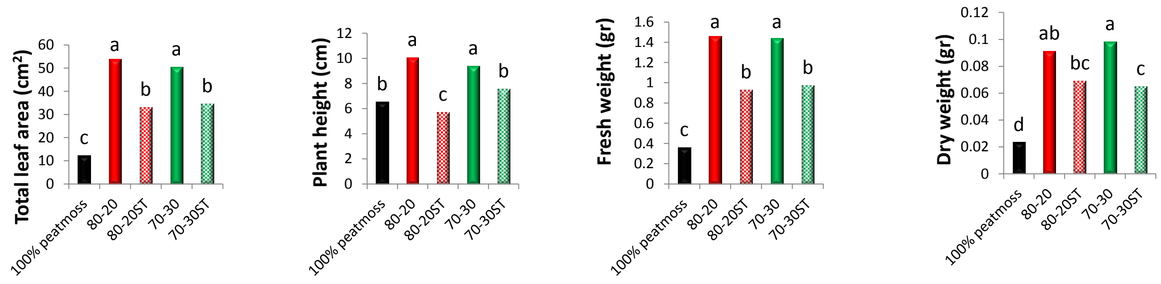
Table 1: List with the bacterial isolates of the rhizosphere exhibiting antimicrobial activity against the fungal pathogens tested in *in vitro* experiments (dual culture technique).

Isolate	Species	Ss	Fox	Forl	Vd	Isolate	Species	Ss	Fox	Forl	Vd
1Ba 38	*Acidovorax sp*				√	2BA 47	*Enterobacter cloacae*			√	√
1Ba 29	*Agrobacterium tumefaciens*				√	2BA 27	*Enterobacter cloacae*			√	√
2Ba 18	*Agrobacterium tumefaciens*				√	2Ba 28	*Enterobacter cloacae*				√
3Ba 41	*Agrobacterium tumefaciens*				√	2Ba 8	*Isoptericola sp*				√
3Ba 3	*Bacillus chandigarhensis*				√	3Ba 35	*Lysinibacillus sphaericus*				√
1Ba 2	*Bacillus endophyticus*				√	2Ba 14	*Lysobacter sp*				√
3Ba 21	*Bacillus endophyticus*				√	2Ba 7	*Microbacterium esteraromaticum*				√
2Ba 55	*Bacillus firmus*				√	3Ba 8	*Microbacterium esteraromaticum*				√
1Ba 43	*Bacillus humi*				√	1Ba 13	*Microbacterium foliorum*				√
1Ba 28	*Bacillus humi*				√	2Ba 37	*Microbacterium foliorum*				√
3Ba 30	*Bacillus humi*				√	3Ba 12	*Microbacterium foliorum*				√
1Ba 18	*Bacillus licheniformis*				√	1Ba 51	*Microbacterium sp*				√
2BA 19 *	*Bacillus licheniformis*	√	√		√	2Ba 33	*Microbacterium sp*				√
3BA 9	*Bacillus licheniformis*	√		√	√	3BA 33	*Microbacterium sp*	√	√		√
3BA 17	*Bacillus licheniformis*	√		√		3Ba 31	*Microbacterium sp*				√
3BA 20	*Bacillus licheniformis*	√			√	2BA 51	*Ochrobactrum sp*			√	√
3BA 28	*Bacillus licheniformis*	√			√	3Ba 34	*Ochrobactrum sp*				√
3BA 44	*Bacillus licheniformis*	√			√	3Ba 38	*Ochrobactrum sp*				√
3BA 45	*Bacillus licheniformis*	√			√	3Ba 22	*Ochrobactrum sp*				√
3Ba 46	*Bacillus licheniformis*				√	2Ba 42	*Ochrobactrum sp.*				√
3Ba 16	*Bacillus licheniformis*				√	3Ba 4	*Pseudomonas putida*				√
1Ba 20	*Bacillus megaterium*				√	2Ba 16	*Pseudomonas sp*				√
2Ba 43	*Bacillus sp*				√	3Ba 2	*Pseudomonas stutzeri*				√
1BA 19	*Bacillus subtilis*	√		√	√	1Ba 45	*Stenotrophomonas maltophilia*				√
2BA 19	*Chryseobacterium sp*			√	√	1Ba 47	*Stenotrophomonas maltophilia*				√
2Ba 21	*Chryseobacterium sp*				√	1Ba 16	*Stenotrophomonas maltophilia*				√
2Ba 10	*Chryseobacterium sp*				√	2BA 32	*Stenotrophomonas maltophilia*			√	√
2Ba 34	*Chryseobacterium sp*				√	2Ba 27	*Stenotrophomonas maltophilia*				√
2Ba 48	*Chryseobacterium wanjuense*				√	2Ba 50	*Stenotrophomonas maltophilia*				√
3Ba 14	*Chryseobacterium wanjuense*				√	3Ba 6	*Stenotrophomonas maltophilia*				√
2Ba 46	*Delftia tsuruhatensis*				√	3Ba 7	*Stenotrophomonas maltophilia*				√
2BA 30	*Enterobacter cloacae*			√	√	3Ba 29	*Stenotrophomonas maltophilia*				√
						2Ba 41	*Tetrathiobacter kashmirensis*				√

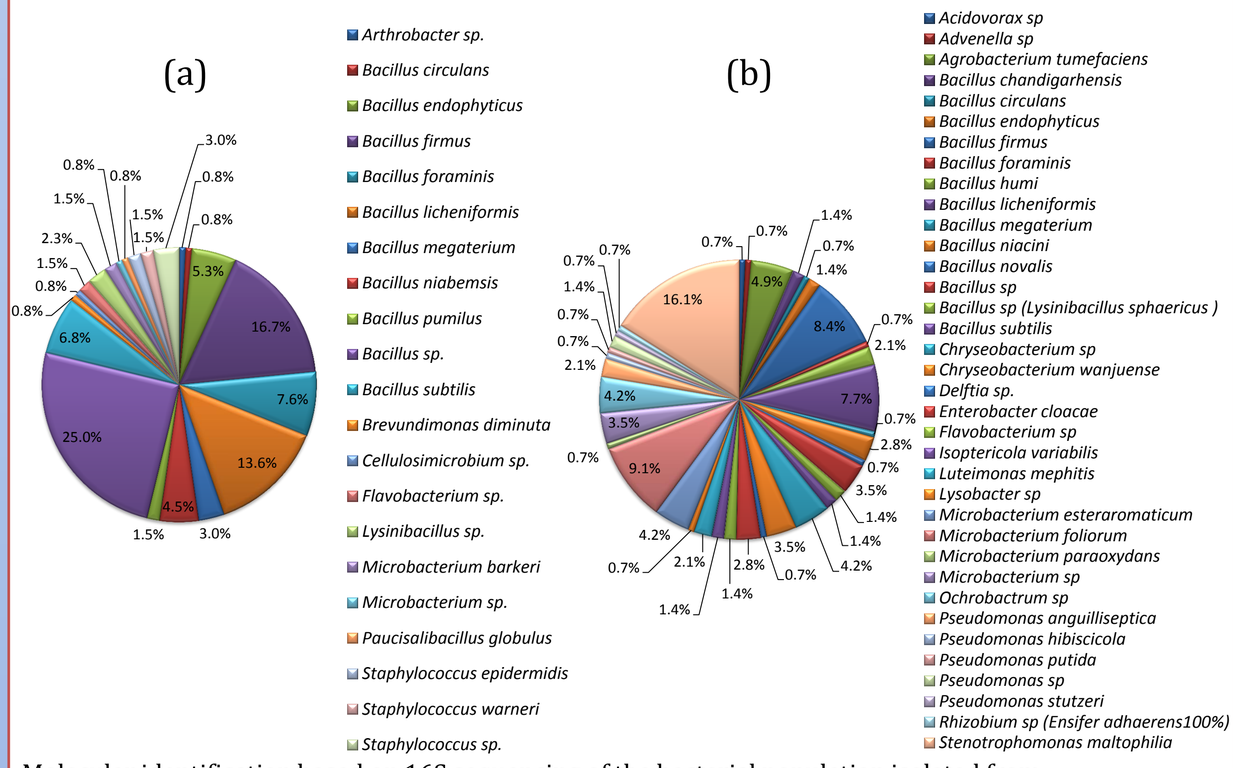
Sc: ***S. sclerotiorum*** **Fox**: ***F. ox.* f. sp *lycopersici*** **Forl**: ***F. ox.* f. sp. radicis-*lycopersici*** **Vd**: ***V. dahliae***



RESULTS



●100% Peatmoss (P), ●80%-20% P-NSC, ●80%-20% P-SC, ●70%-30% P-NSC, ●70%-30% P-SC



Molecular identification based on 16S sequencing of the bacterial population isolated from:
(a) the compost and (b) the rhizosphere.

RESULTS

Table 2: Potential of plant growth promoting traits by bacteria isolated from the rhizosphere of tomato plants grown in a suppressive compost.

Isolate	Species	Pectinase activity	Cellulase activity	Protease activity	Chitinase activity	$Ca_3(PO_4)_2$ solubilazation	IAA production	Biofilm formation
3BA3	*B. chadirgarhensis*	√	√					√
2BA55	*B. firmus*	√	√					
1BA2	*B. endophyticus*	√	√				√	
3BA21	*B. endophyticus*						√	
1BA28	*B. humi*		√					√
1BA43	*B. humi*		√				√	√
1BA18	*B. licheniformis*	√			√			√
3BA9	*B. licheniformis*	√			√	√		√
3BA16	*B. licheniformis*	√			√	√	√	√
3BA17	*B. licheniformis*	√			√	√		√
3BA20	*B. licheniformis*	√			√			√
3BA28	*B. licheniformis*	√			√			√
3BA44	*B. licheniformis*	√			√			
3BA45	*B. licheniformis*	√			√			√
3BA46	*B. licheniformis*	√		√	√			√
1BA20	*B. megaterium*	√	√	√				√
CCS	*B. subtilis*	√		√		√		√
1BA19	*B. subtilis*	√	√	√		√		√
2BA19*	*B. subtilis*	√	√	√		√		√
2BA43	*Bacillus sp.*		√					√
3BA30	*Bacillus sp.*			√	√		√	√
3BA35	*Bacillus sp.*					√	√	√
3BA33	*Microbacterium sp.*	√				√	√	√

DISCUSSION & CONCLUSIONS

- The microorganisms inhabiting the compost are likely responsible for the suppressive properties observed and may act as growth promotion inducers with high degree of functional and genetic diversity.
- These isolates are considered to play a vital role in disease suppression and plant growth promotion due to their potential of producing an array of antifungal metabolites, hormones and plant growth promoting enzymes.
- The mechanisms of plant growth promotion and pathogen suppression are an isolate-specific characteristic rather than a common trait of a particular bacterial species.