

# Supporting Information

## A green approach to copper-containing pesticides: antimicrobial and antifungal activity of brochantite supported on lignin for the development of bio-based plant protection products

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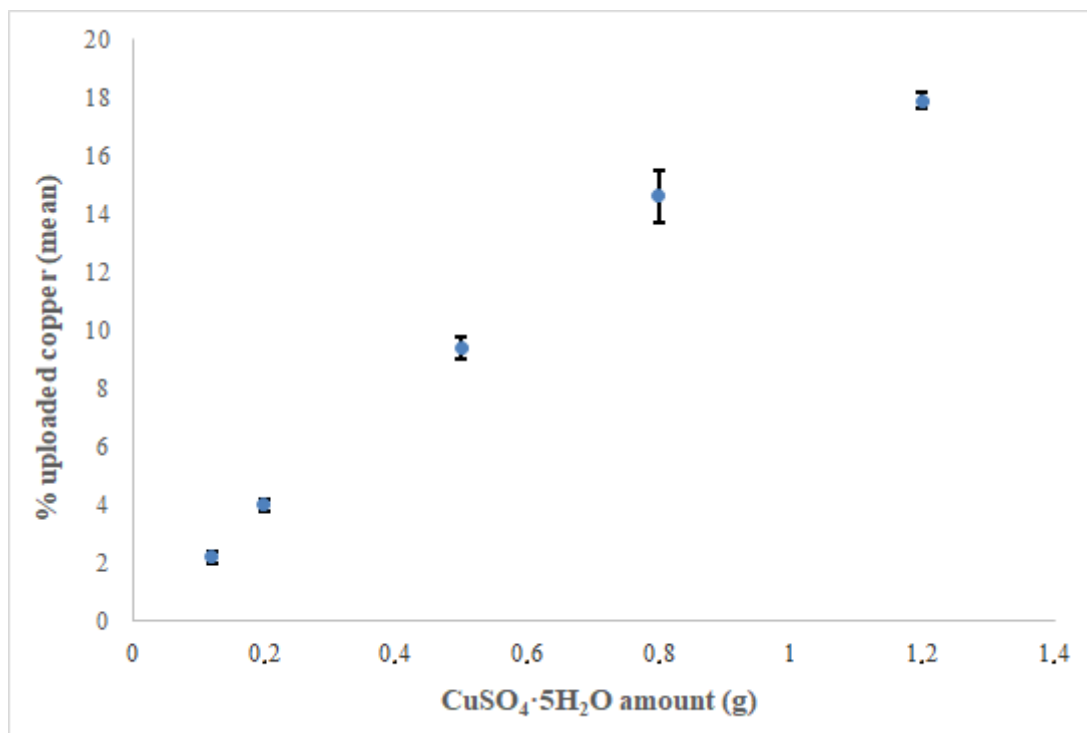
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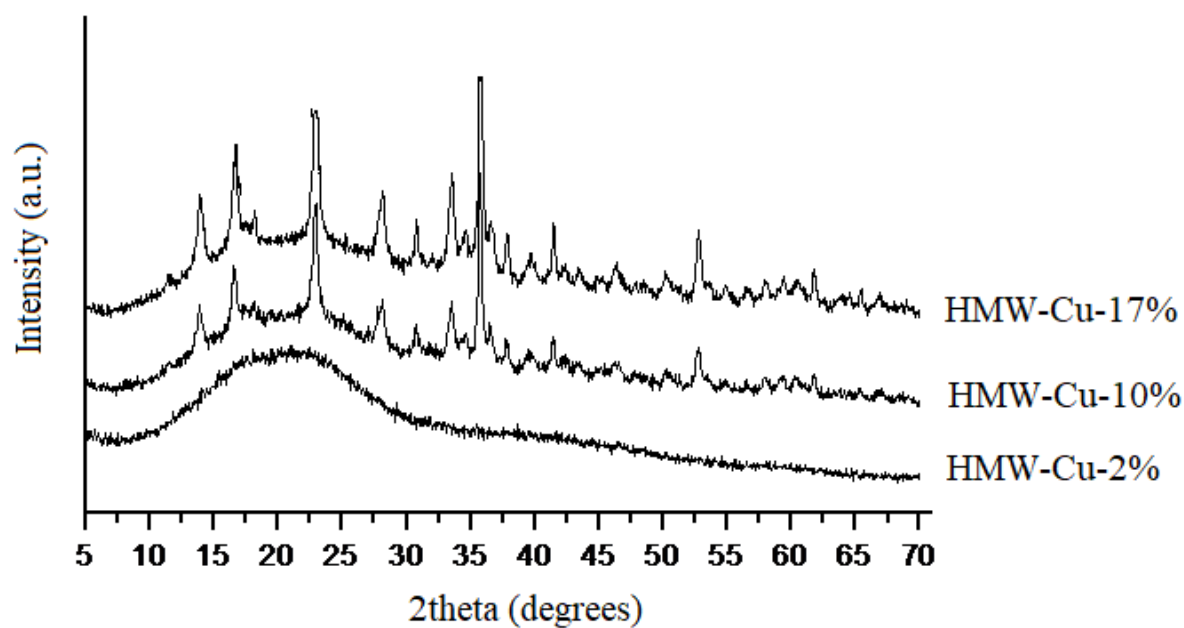
E mail: [dominga.rogolino@unipr.it](mailto:dominga.rogolino@unipr.it)

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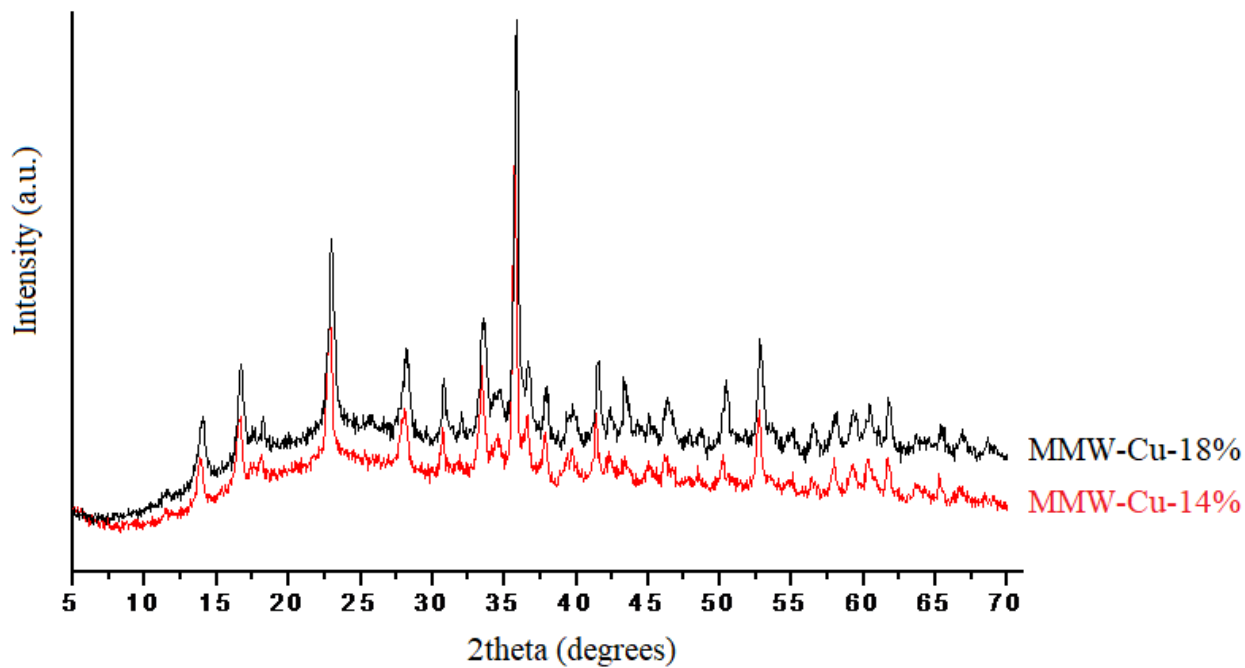
This supporting information includes 8 pages, 7 figures and 5 tables.



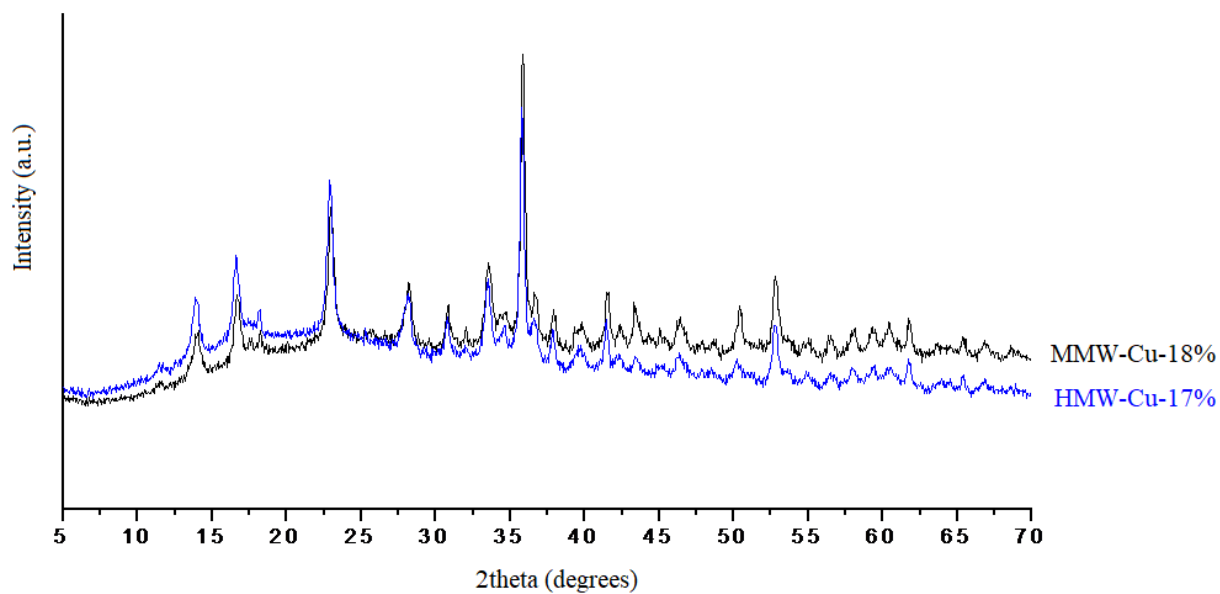
**Figure S1.** Proportionality between the amount of salt added to MMW lignin and the % of uploaded copper.



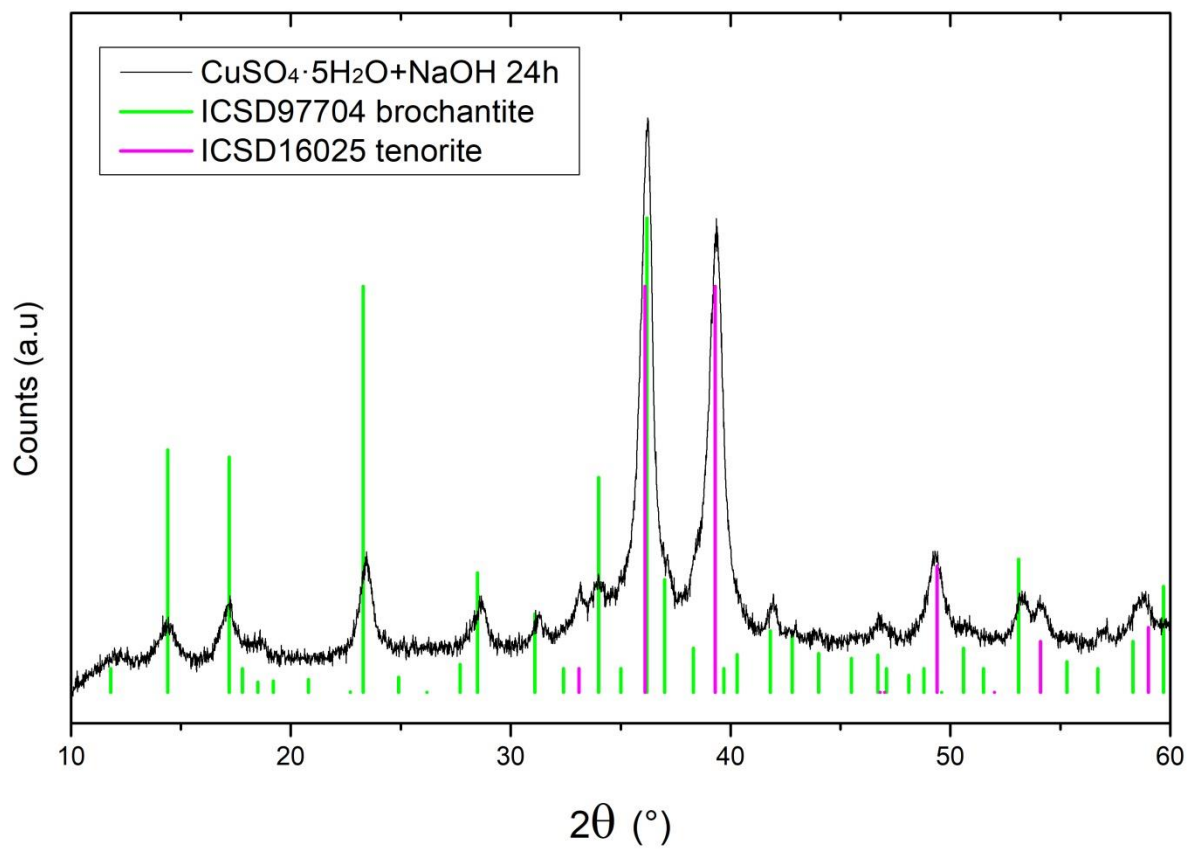
**Figure S2.** Overlap of XRPD plots of HMWCu\_17%, HMWCu\_10% and HMWCu\_2%.



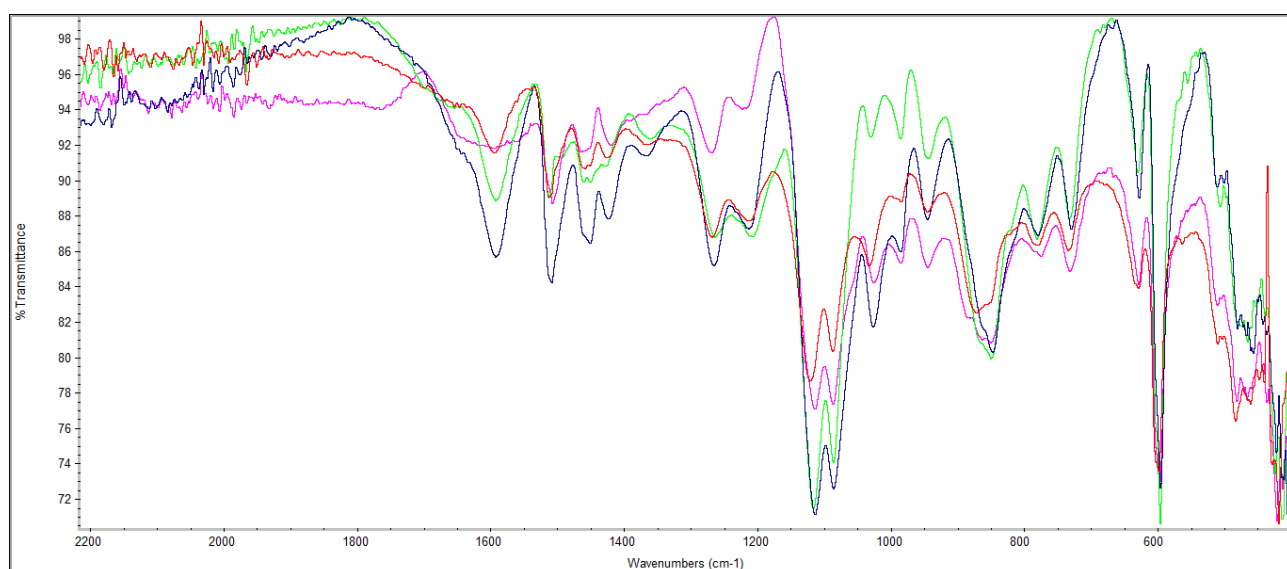
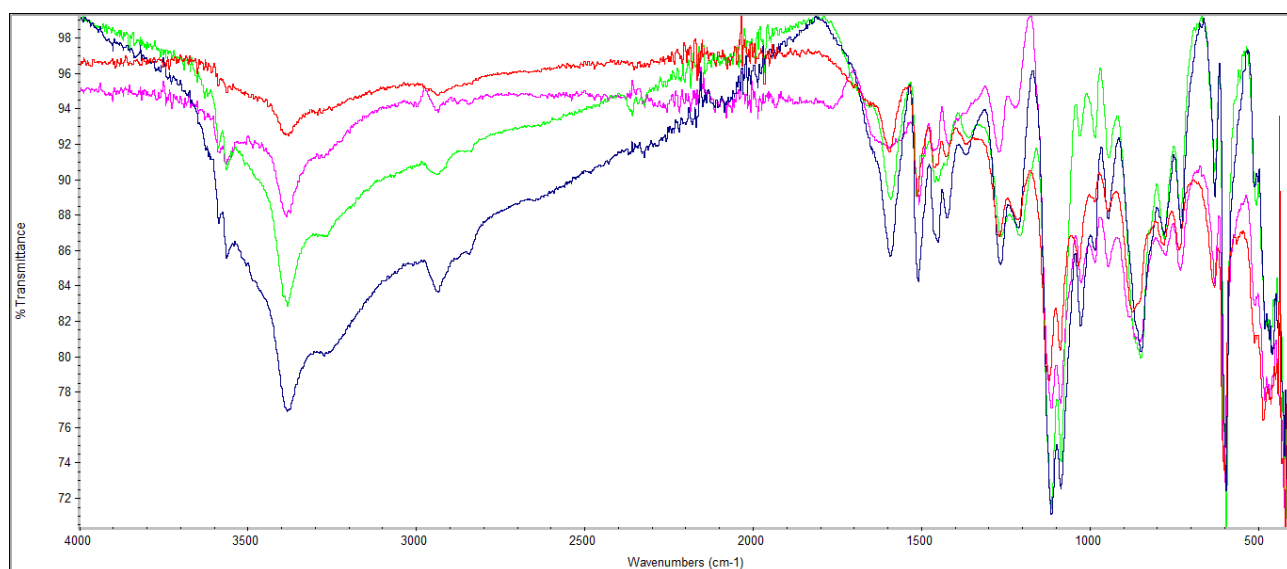
**Figure S3.** Overlap of XRPD plots of MMWCu\_18% and MMWCu\_14%.



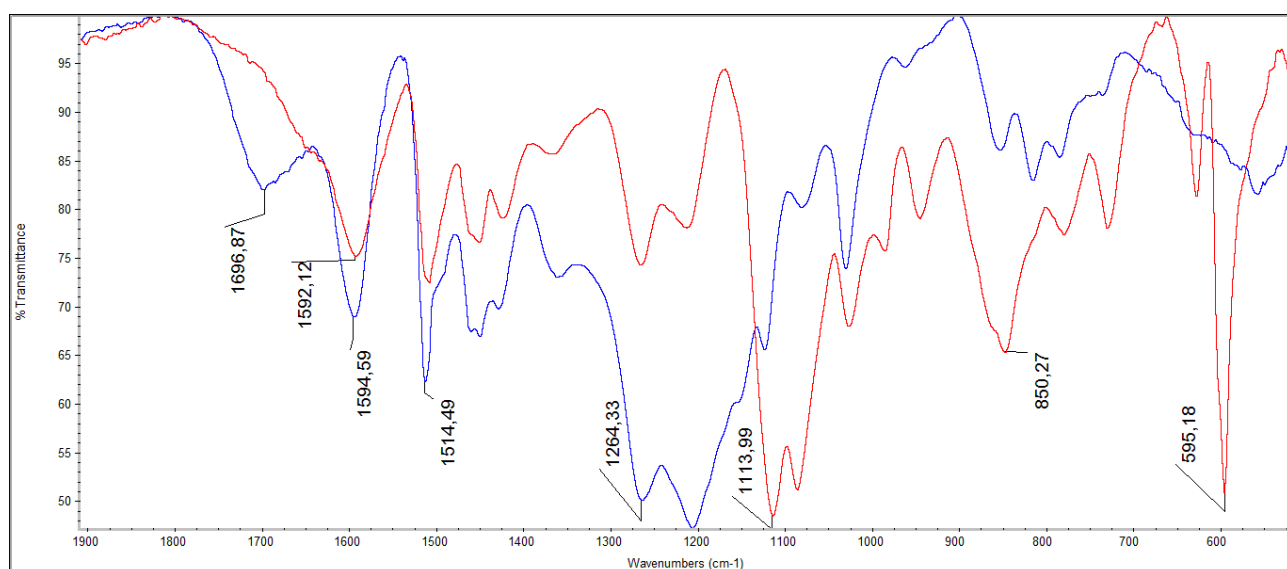
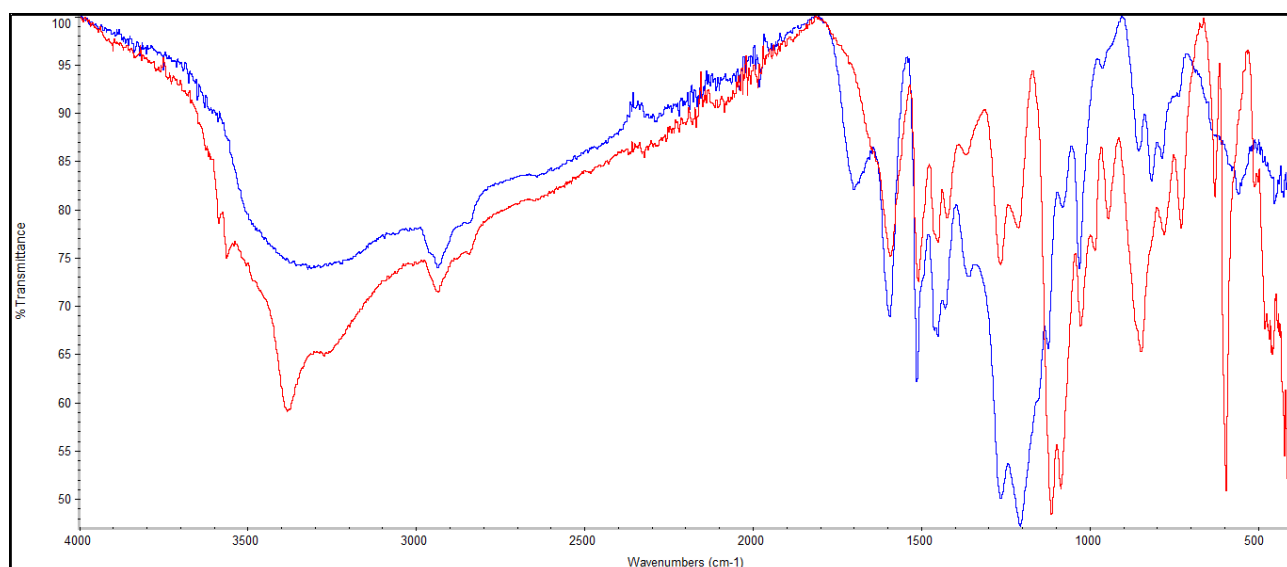
**Figure S4.** Overlap of XRPD plots of MMWCu\_18% and HMWCu\_17%.



**Figure S5.** Matching between XRPD plot of CuSO<sub>4</sub>·5H<sub>2</sub>O+NaOH 24 h (black), Tenorite (pink lines), and Brochantite (green lines).



**Figure S6.** Comparison between FT-IR spectra of HMWCu\_14% (purple), HMWCu\_17% (red), MMWCu\_14% (blue) and MMWCu\_18%, whole  $\text{cm}^{-1}$  range (top) and zoom (bottom).



**Figure S7.** Comparison between FT-IR spectra of MMW (blue) and MMWCu\_14% (red),

whole  $\text{cm}^{-1}$  range (top) and zoom (bottom).

**Table S1.** Growth medium and related temperature and time conditions for the studied bacteria.

<b>Microorganism</b>	<b>Colture medium</b>	<b>Temperature and time</b>
<i>Escherichia coli</i>	YPGB pH 7±0.2	35 °C ±2, 24 h
<i>Pseudomonas aeruginosa</i>	YPGB pH 7±0.2	35 °C ±2, 24 h
<i>Staphylococcus aureus</i>	YPGB pH 7±0.2	35 °C ±2, 24 h
<i>Salmonella enteridis</i>	YPGB pH 7±0.2	35 °C ±2, 24 h
<i>Erwinia amylovora</i>	YPGB pH 7±0.2	35 °C ±2, 24 h
<i>Pseudomonas syringae pv actinidiae</i>	YPGB pH 7±0.2	35 °C ±2, 24 h
<i>Xanthomonas campestris</i>	YM Broth pH 6.2±0.2	35 °C ±2, 24 h
<i>Campylobacter jejuni</i>	Blood-free selective medium for isolation of <i>Campylobacter jejuni</i> , pH 7.4±0.2	35 °C ±2, 48 h
<i>Xanthomonas arboricola pv pruni</i>	YM Broth pH 6.2±0.2	35 °C ±2, 48 h

**Table S2.** Growth medium and related temperature and time conditions for the studied yeasts and fungi.

<b>Microorganism</b>	<b>Colture medium</b>	<b>Temperature and time</b>
<i>Candida albicans</i>	YM pH 6.2±0.2	30 °C ±2, 48 h
<i>Alternaria solani</i>	PDB pH 5±0.2	30 °C ±2, 72 h
<i>Botrytis cinerea</i>	PDB pH 5±0.2	30 °C ±2, 72 h
<i>Fusarium solani</i>	PDB pH 5±0.2	30 °C ±2, 72 h
<i>Rhizoctonia solani</i>	PDB pH 5±0.2	30 °C ±2, 72 h
<i>Monilia laxa</i>	V8 juice pH 5.7±0.2	30 °C ±2, 72 h
<i>Septoria tritici</i>	V8 juice pH 5.7±0.2	30 °C ±2, 96 h

**Table S3.** Experimental conditions used for tests in greenhouse.

<b>Crop</b>	<i>Solanum lycopersicum</i> /Tomato	<b>Target disease</b>	Rhizoctonia sp.
<b>Variety:</b>	Cuore del Ponente	<b>Replicates:</b>	3
<b>Plot</b>	1.5 mt x 1.5 mt	<b>Plot size:</b>	2.25 m <sup>2</sup>
<b>Plots:</b>	21	<b>Plants/plot:</b>	10
<b>Trial design</b>	randomised complete block		

**Table S4.** Crop information and details

<b>Crop / variety:</b>	Tomato/Cuore del Ponente	<b>Date of planting:</b>	13 March 2018
<b>Plants/ha:</b>	About 222223	<b>Distance in/between</b>	0.15 mt/ 0.3 mt
<b>Growing system:</b>	Pots	<b>Soil type:</b>	Clay/Loam
<b>Date of harvest :</b>	Beginning of May	<b>Previous crop:</b>	Ornamentals
<b>Crop conditions</b>	The plants were in good vegetative conditions and were maintained in good		

**Table S5.** Application schedule for tested compounds

<b>Product/Form.</b>	<b>Copper conc.</b>	<b>Dosage rate/ha</b>	<b>Application timing</b>
HMWCu_10 10%	10 g/l	3 l	A-B-C
Commercial Cu(OH) <sub>2</sub>	20 g/100 g	3,0 kg	A-B-C
<b>Application Timing</b>			<b>Spray Volume</b>
All thesis	A = at transplanting and 24/48 h after artificial inoculation B = 15 Days After Application A C = 7-10 Days After Application B and 48 h after second artificial inoculation		500 l/ha