SiO_2 applications as an alternative to insect control in greenhouses

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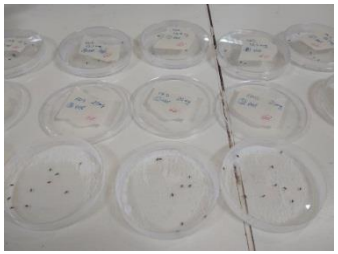

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The integration of silicon dioxide (SiO_2) in agriculture

- ✓ Eco-friendly, non-toxic substance
- ✓ Alternative method to chemical applications in agriculture
- ✓ Mode of SiO_2 action: adherence and friction of its nanoparticles on the insect's exoskeleton
- ✓ Result: water loss, dehydration and insect mortality

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The integration of silicon dioxide (SiO_2) on the insect-proof screens' surface

- ✓ Active protection of greenhouse crops from pest invasions due to a special SiO_2 coating
- ✓ Ventilation and greenhouse microclimate optimization, as the efficacy of SiO_2 could promote the use of lower mesh size screens
- ✓ Food sustainability without chemical residues

The aim of the study

- ✓ The evaluation of different SiO_2 formulations against tolerant stored-product insects
- ✓ The evaluation of different SiO_2 – coated screens against tolerant stored-product insects
- ✓ The further installation of the screens into greenhouse vent openings

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Materials and Methods

Lab experiments with silica nanoparticles

2 target species

- ✓ *Sitophilus oryzae* adults
- ✓ *Tribolium confusum* larvae

3 silica formulations

- ✓ *S200*
- ✓ *S200 – OH*
- ✓ *S200 - MEC*

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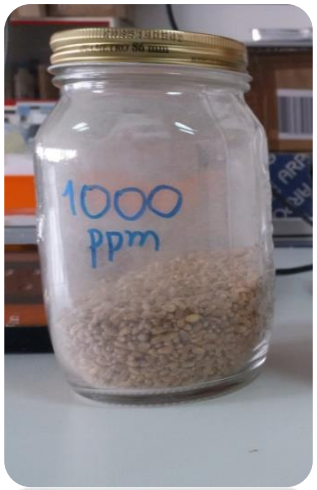
Materials and Methods

Lab experiments with silica nanoparticles

Assessment of the different formulations of **Silicon dioxide (SiO_2) nanoparticles** against:

- ✓ *Sitophilus oryzae* adults, and
- ✓ *Tribolium confusum* larvae



20 insects, 3 replications / treatment

Evaluation after 1 and 7 days of exposure

Materials and Methods

Lab experiments with silica coated screens

2 target species

- ✓ *Sitophilus oryzae* adults
- ✓ *Tribolium confusum* larvae

5 insect-proof screens

SiO_2-screens	Organic primer	SiO_2 particle diameter (μm)	Coating repetition	SiO_2 mass on the screen's surface (g m^{-2})
S200-1	-	2-4	1	1.2
S200-3	-	2-4	3	1.7
S200-0-P	Paraffin	2-4	0	15.4
S200-1-P	Paraffin	2-4	1	2.1
S200-2-P	Paraffin	2-4	2	2.5

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Materials and Methods

Lab experiments with silica coated screens

Assessment of an insect-proof screen **coated with different SiO_2** against:

- ✓ *Sitophilus oryzae* adults, and
- ✓ *Tribolium confusum* larvae

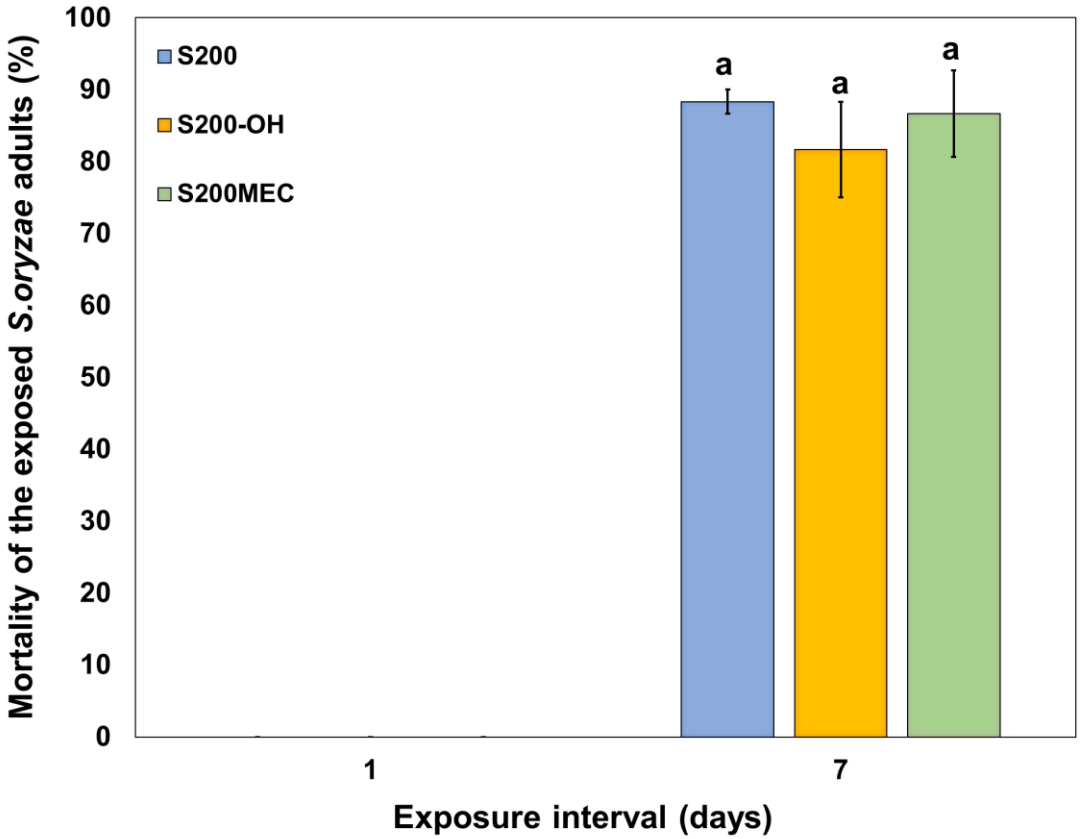
10 insects exposed for 72 hours, 3 replications / treatment

Evaluation after 1, 3, 5 and 7 days after the exposure

Results

Lab experiments with silica nanoparticles

Assessment of three formulations of **Silicon dioxide (SiO_2) nanoparticles** against ***S. oryzae***



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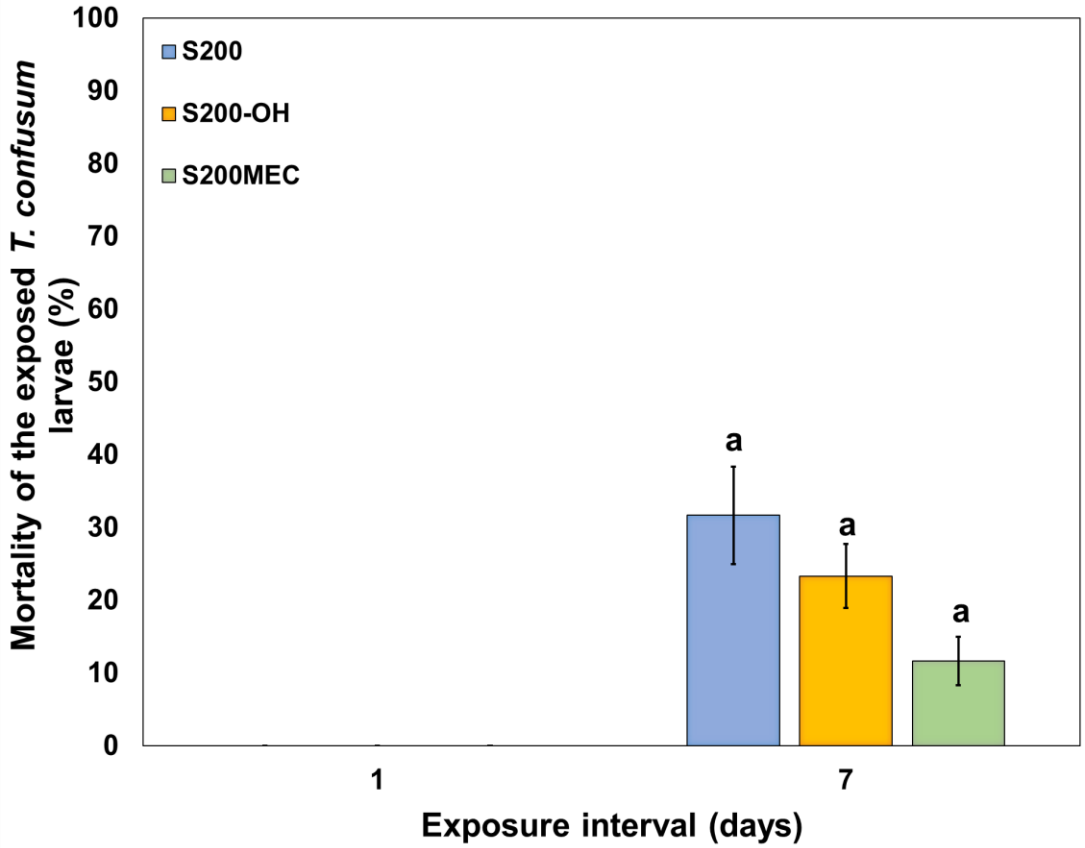
Results

Lab experiments with silica nanoparticles

Assessment of three formulations of **Silicon dioxide (SiO_2) nanoparticles** against ***T.confusum***



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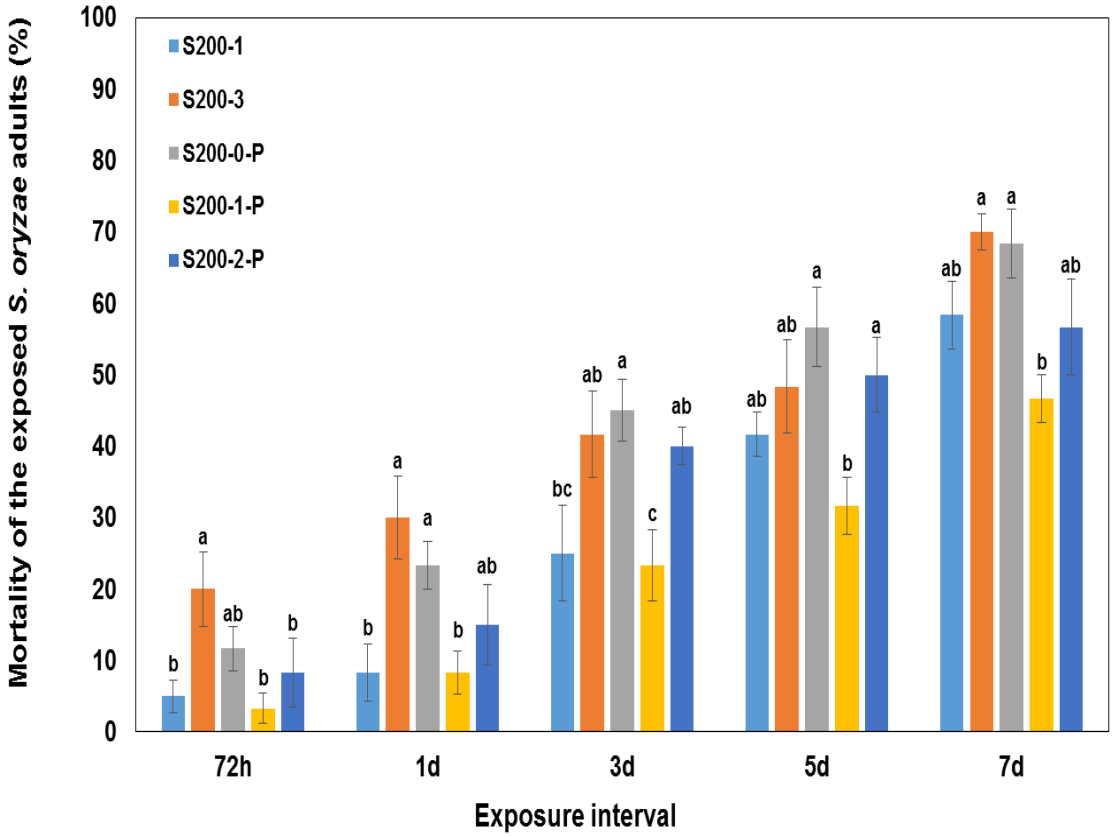
Results

Lab experiments with silica coated screens

Assessment of an insect-proof screen **coated with different SiO_2** against ***S. oryzae***



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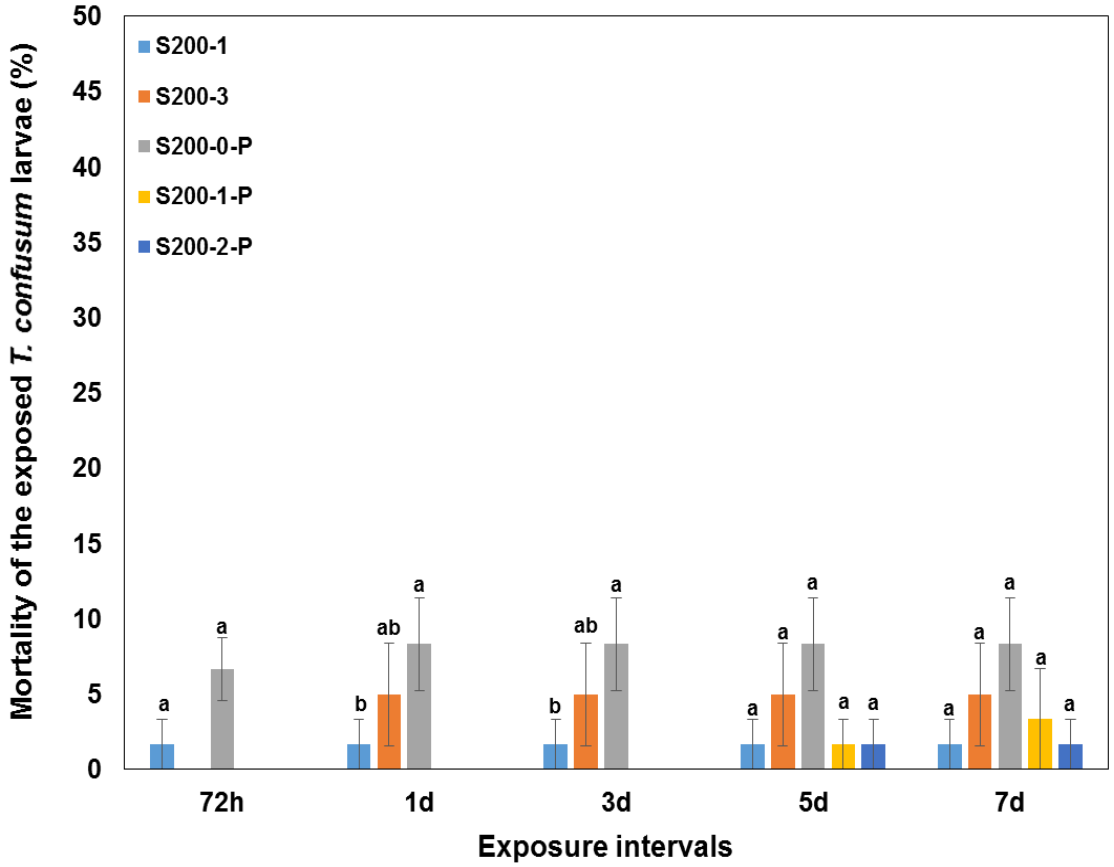
Results

Lab experiments with silica coated screens

Assessment of an insect-proof screen **coated with different SiO_2** against ***T. confusum***



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Conclusions

❖ Lab experiments with silica nanoparticles

None of the tested stored-product insects were affected 1 day after the exposure

✓ *S. oryzae → Maximum mortality (88%) after 7 days of exposure to all treatments*

✓ *T. confusum → Maximum mortality (32%) after 7 days of exposure to S200*

❖ Lab experiments with silica coated screens

✓ *S. oryzae → Maximum mortality (up to 70%) after 7 days of exposure to all treatments except S200-1-P (47%)*

✓ *T. confusum → Mortality was less than 10% after 7 days of exposure to all treatments*

✓ *paraffin did not have a significant effect in insect mortality*

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Conclusions

- ✓ *SiO_2 nanoparticles are effective as an alternative biological insect control agent, as delayed mortality was promoted after 7 days of post-exposure to the treated screens*

- ✓ *SiO_2 offers an innovative technological solution for sustainable agriculture, preserving pest management, whilst minimizing the environmental footprint through its non-toxic and pesticide-free basis*

- ✓ *Thus, the SiO_2 – coated screens could be efficiently incorporated in greenhouses as greenhouse pests are considered more susceptible as compared to stored-product insects*

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Thank you for your attention

Acknowledgments

This research has been co-financed by the European Union and Greek national funds through the National Action "Bilateral and Multilateral E&T Cooperation Greece - Germany" (project code: T2DGE-0120).

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