Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary Information

Fluorophore-Free Luminescent Double-Shelled Hollow Mesoporous Silica Nanoparticles as Pesticide Delivery Vehicles

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Bioactivity of Py@F-DSH-MSNs against Cucumber Powdery Mildew

A preventive assay was used to evaluate the bioactivity of the prepared Py@F-DSH-MSNs against cucumber powdery mildew pathogen using a pot experiment.

Preparation of conidial suspension. Conidia of powdery mildew were collected from naturally infected cucumber leaves, and the fungus was identified as *Podosphaera xanthii*. Conidia were gently brushed into a small quantity of sterile distilled water containing two drops of Tween 80 and counted with the aid of a hemocytometer to give a suspension of 1×10^6 conidia/mL.

Preventive bioactivity assay. The bioassay experiment was conducted in the greenhouse under natural photoperiod with a temperature of 28-35°C, and a humidity of 60-85%. Briefly, cucumber plants were grown in potting soil-filled plastic pots at a density of three seedlings per pot. When cucumber plants grown with two fully developed leaves, three concentrations of pyraclostrobin (111, 222, and 333 mg/L) prepared from Py@F-DSH-MSNs suspension were sprayed evenly onto the cucumber leaves until run-off using a micro-sprayer. For comparison, the same concentrations of pyraclostrobin prepared from commercial suspension concentrate (SC) were sprayed. Distilled water was used as control check. Each concentration was applied three pots. After the pesticide treatment, plants were allowed to dry for 24 h before inoculation with fresh conidial suspensions. The spore suspension was sprayed on the whole surface of cucumber leaves using a micro-sprayer. Disease severity was scored at 10 days post-inoculation on all leaves by assessing the percentage of infected leaf

area covered by white powdery mildew sporulation with a rating (r) of 0, 1, 3, 5, 7 and 9, where 0 = no symptoms, 1 = 0–5%, 3 = 6–15%, 5 = 16–25%, 7 = 26–50%, 9 = >50%. The disease index (DI) and the control effects (CE) were calculated using the following equations:

$$DI(\%)=\frac{\sum(N_r \times r)}{N_t \times 9}\times 100$$

$$CE(\%)=\frac{D_u - D_t}{D_u}\times 100$$

where r = rating value, N_r = number of disease leaves with a rating of r, and N_t = total number of leaves tested; D_u is the mean DI in the untreated control plots, and D_t is the mean DI in the treated plots.

Table S1. Control effect of pyraclostrobin on cucumber powdery mildew 10 days after inoculation with fresh conidial suspensions under different treatments.[a]

Treatment	Concentration (mg/L)	Disease Index (%)	Control Effect (%)
Py SC[b]	111	13.52 ± 1.16	56.93 ± 3.71
	222	8.38 ± 0.94	73.30 ± 3.01
	333	6.02 ± 0.74	80.81 ± 2.36
Py@F-DSH-MSNs	111	14.36 ± 2.13	54.28 ± 6.77
	222	9.08 ± 1.11	71.08 ± 3.55
	333	6.74 ± 1.01	78.54 ± 3.52
CK	–	32.15 ± 1.18	–

[a]The data are mean value ± SD. [b] Py SC: pyraclostrobin suspension concentrate.

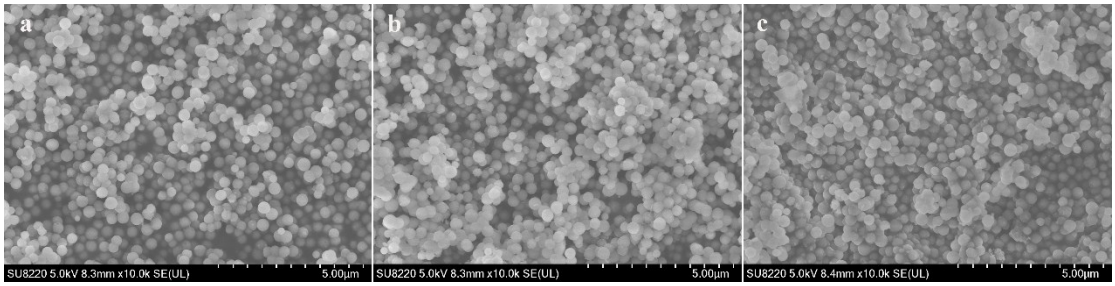

Figure S1. SEM images of the as-prepared Py@F-DSH-MSNs (a) and those under treatment with aqueous extracts of soil (b) and cucumber leaves (c) for 48 h using a shaking table.

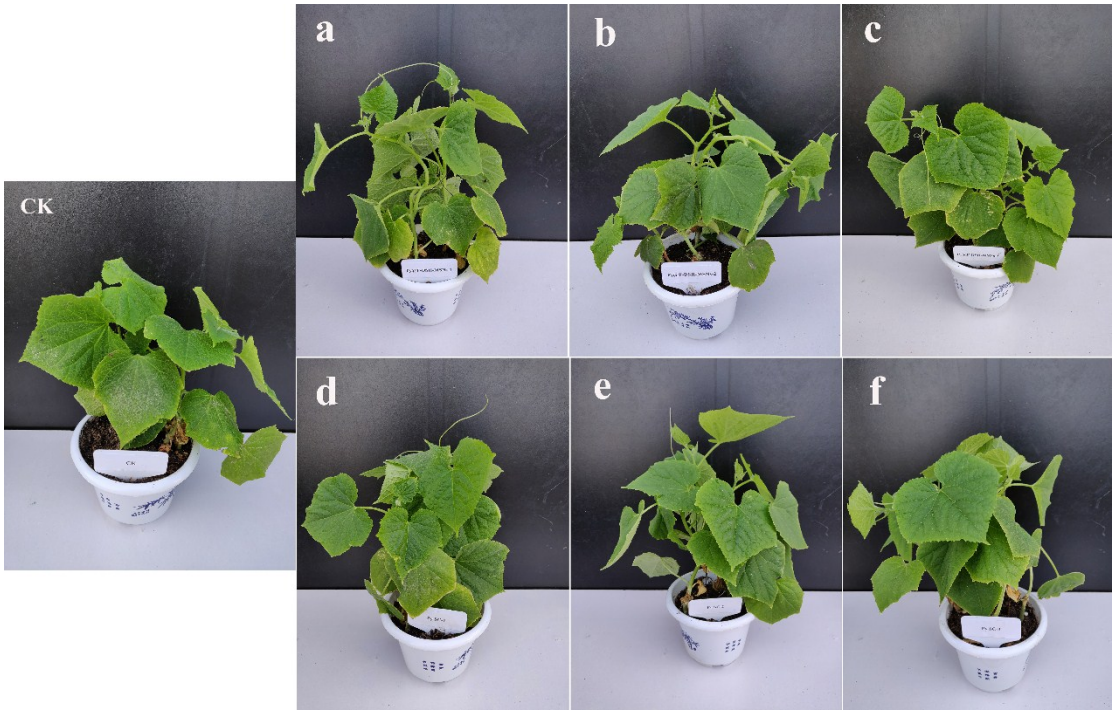

Figure S2. Images of cucumber plants on the 10th day after inoculation with fresh powdery mildew conidial suspensions under different treatments (CK: control check; a-c: treatments with Py@F-DSH-MSNs under pyraclostrobin concentrations of 111, 222, and 333 mg/L, respectively; d-f: treatments with Py SC under pyraclostrobin concentrations of 111, 222, and 333 mg/L, respectively).