# Supporting Information

**Efficiency of Lignin nanocapsules for delivering neem oil and capsaicin against pest insects: insights from the system *Eruca sativa – Plutella xylostella*.**

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Table SI 1: Leaf area increment (cm$^2$) without any disturbance obtained after

|  | 24h | 72h | 168h |
|---|---|---|---|
| Water | 2.5 ± 0.4 | 3 ± 0.2 | 4.9 ± 0.9 |
| Capsaicin | 2.2 ± 1.4 | 2.8 ± 1.8 | 5 ± 1.5 |
| Neem oil | 2.5 ± 1.6 | 2.5 ± 1.5 | 4.8 ± 1 |

*Both Capsaicin and Neem oil were dispersed in water.

Table SI 2: Leaf area increment (cm$^2$) and in the presence of parasites.

|  | 24h | 72h | 168h |
|---|---|---|---|
| Water | 3 ± 0.7 | 3.4 ± 0.9 | -2.7 ± 0.4 |
| Capsaicin | 2.5 ± 1.2 | 2.6 ± 1.8 | - 2.5 ± 1.3 |
| Neem oil | 2.7 ± 1.4 | 2.5 ± 1.2 | - 2.3 ± 1.2 |

*Both Capsaicin and Neem oil were dispersed in water.

The calibration curve of Capsaicin in ethanol was recorded in the concentration range 0.005-0.8 mg/ml. The coefficient of the linear correlation was R² = 0,9961 (y = 12,732x + 0,0571).
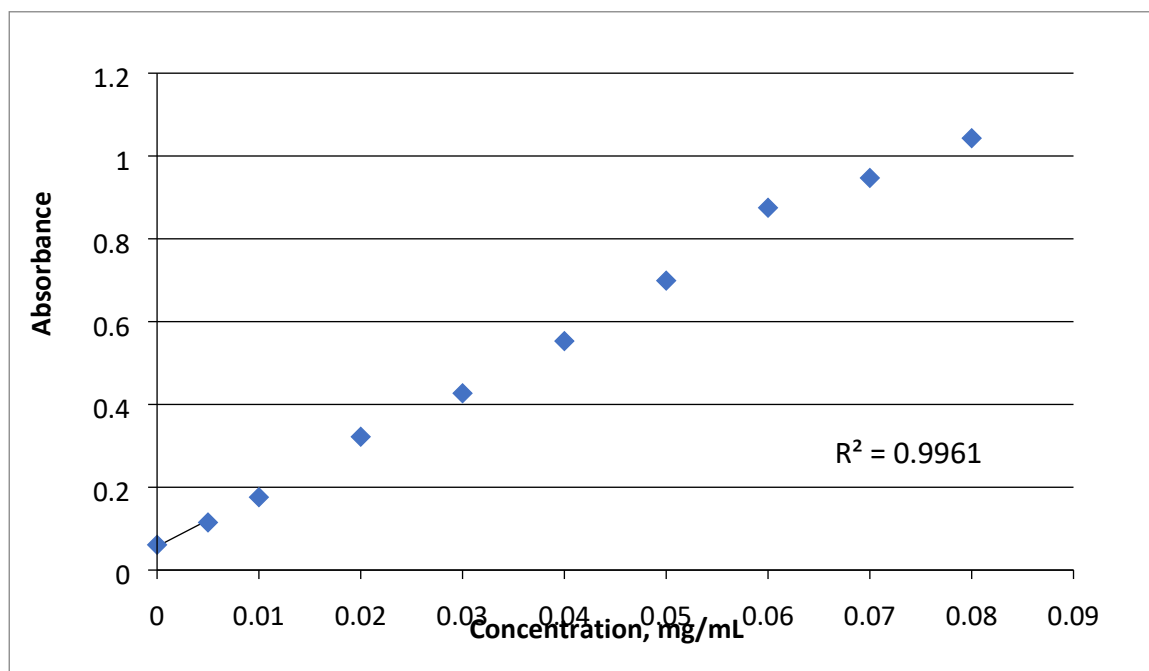
Figure SI 1: Absorbance of Capsaicin measured at 288nm as a function of the concentration (mg/mL). The linear correlation is y= 12.732x + 0.0571 with $R^2$= 0.9961

NCs disruption was obtained by 1-hour agitation of the samples after dichloromethane addiction 1:1 (v/v). After the centrifugation at 3000 rpm for 15 minutes, dichloromethane containing capsaicin was recovered and dried. The powder was suspended in 2mL of ethanol and measured by spectrophotometer UV/VIS.

The amount of Capsaicin was obtained by subtracting the values obtained from the subtraction of the absorbance of NC loaded with capsaicin at 288nm (absorbance wavelength of capsaicin) and the interpolated curve and that calculated from the UV/VIS curve of empty NC (Figure SI 2) and its interpolation.

The amount of Capsaicin was calculated considering the signal obtained from that respective of empty NC at 288nm as shown in Figure SI 2.
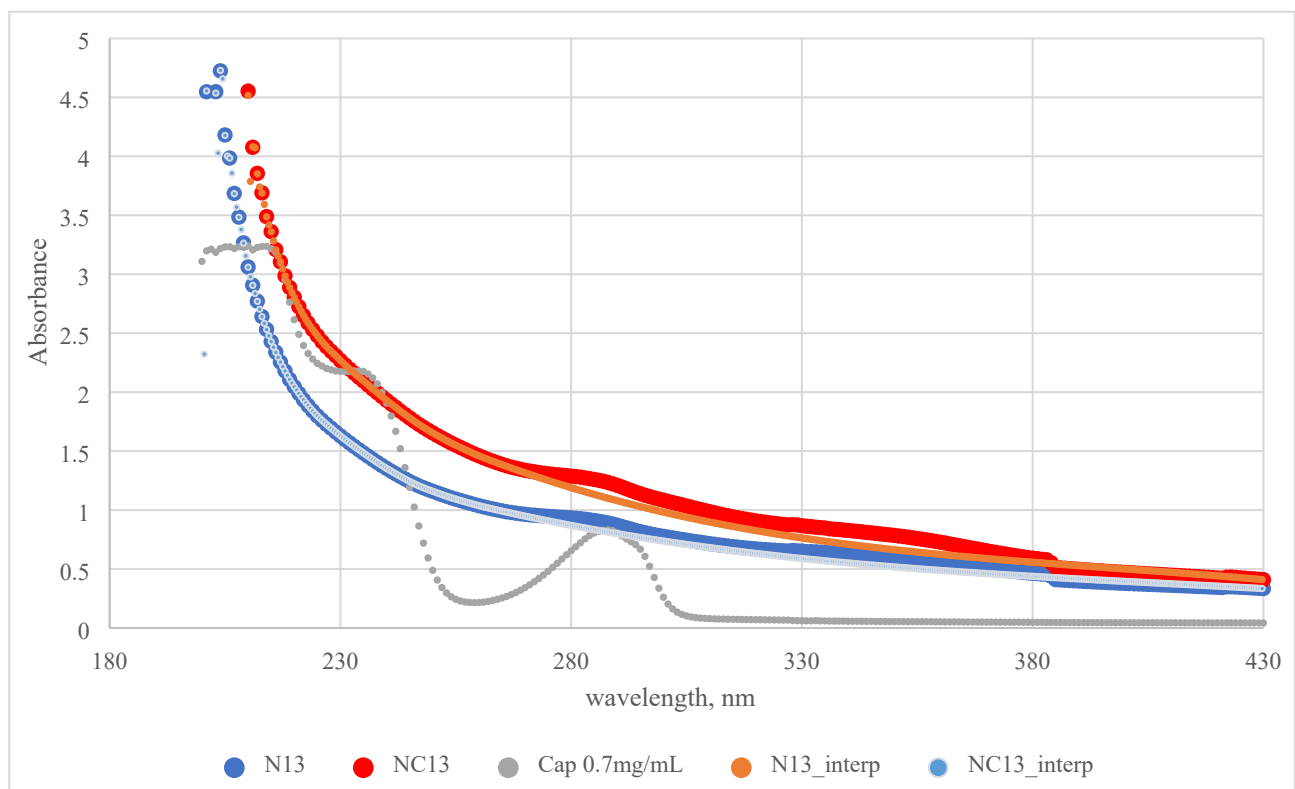
Figure SI 2: UV/VIS curves of NC13 and N13 curves with the respective interpolation curve N13 and NC13.



Figure SI3: Examples of the spray used in the treatments. The total volume sprayed for the three replicate were 1.5mL (500μL for each plant).
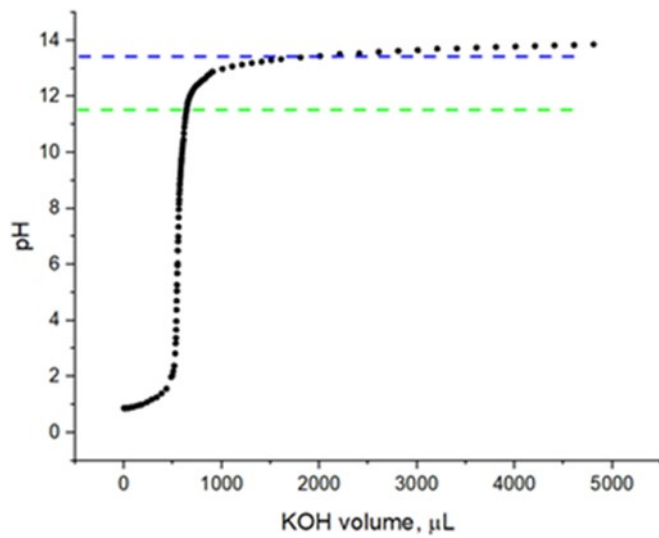
Figure SI 4: Titration curve of an aqueous solution of Lignin (1% w/v) and chosen pH values for aqueous dissolution. The green and blue dashed lines indicate the level of pH 11.5 and 13.5, respectively.
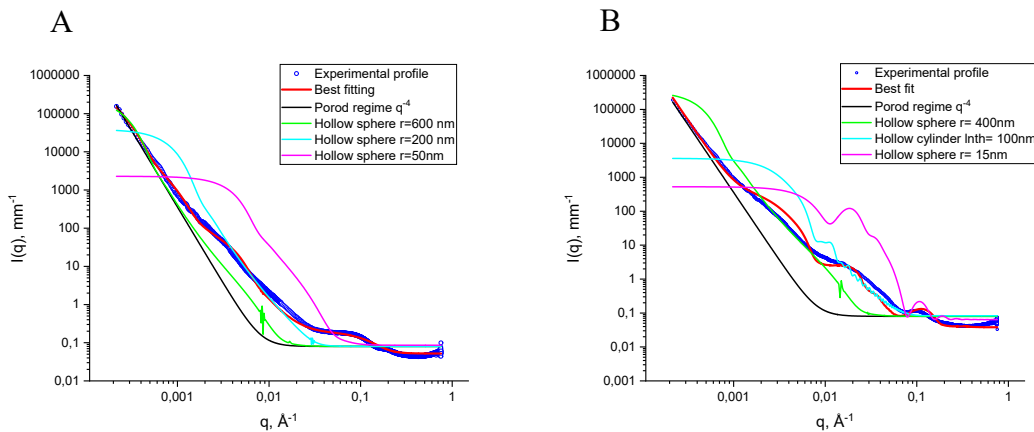
A

B



Figure SI 5: SAXS intensity diagrams of N13 (A) and N11 (B). Blue circles: experimental data; continuous red lines: best-fitting obtained with the contributions listed below. The calculated contributions to the best fit were vertically translated for the sake of clarity.

I(q) for nN13: *((Gi\*0,65+H₁\*0,8+H₂\*0,08+H3\*0,04)\*0,7)-0,05*

*Gi*: Power law contribution $q^{-4}$

*H₁*: Hollow sphere r=600nm thk=64nm

*H₂*: Hollow sphere r=200nm thk=12 nm

*H₃*: Hollow sphere r=50nm thk= 34 nm

I(q) for nN11: *((G₁\*15+H₄\*0,04+C₁\*1,2+H₅\*0,18)\*0,1)-0,09*

*Gi*: Power law contribution $q^{-4}$

*H₄:* Hollow sphere  r=400 nm thk=20 nm

*C₁*: Hollow cylinder r=50nm thk=20 nm; lth= 100 nm

*H₅*: Hollow sphere r=15 nm thk= 8nm