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Lab-on-chip platform for on-field analysis of Grapevine leafroll-associated virus 3

Ilaria Buja[1,2]*, Erika Sabella[3], Anna Grazia Monteduro[1,2], Maria Serena Chiriacò[2], Rizzato Silvia[1,2], Luigi De Bellis[3], Andrea Luvisi[3] and Giuseppe Maruccio[1,2]

1 Department of Mathematics and Physics "Ennio De Giorgi", University of Salento, Omnics Research Group, Via per Monteroni, 73100 Lecce, Italy;
2 Institute of Nanotechnology, CNR NANOTEC, Via per Monteroni, 73100 Lecce, Italy;
3 Department of Biological and Environmental Sciences and Technologies, University of Salento, via Monteroni, Lecce, 73100, Italy

* Corresponding author: Ilaria.buja@unisalento.it

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Abstract:

Human activities, especially the globalization of trade or tourism mass, had lead to he spreading of phytopathological adversities, all over the world.

These pathogens can have serious economic/environmental repercussions, due to the absence of therapeutic techniques and the need of rapid, in-field and low-cost detection methods.

Here we present a Lab-on-chip (LOC) platform, with electrochemical transduction method, recognizing serial dilutions of Grapevine leafroll-associated virus 3 (GLRaV-3).

LOC require small sample volumes, allowing a rapid detection of the target.

Keywords: Plant pathogens, environmental monitoring, sensors, lab-on-chip

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Host

Vector

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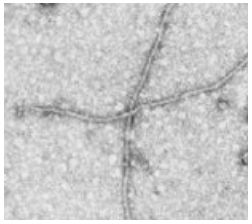
Pathogen



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(Maree *et al.*, 2013 – licensed under the Creative Commons Attribution.)

Significant yield losses!

An estimated economic impact from $ 25,000 to $ 40,000 per hectare, in the absence of any control measure (Atallah *et al.*, 2012)

sensors

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Review

Advances in Plant Disease Detection and Monitoring: From Traditional Assays to In-Field Diagnostics

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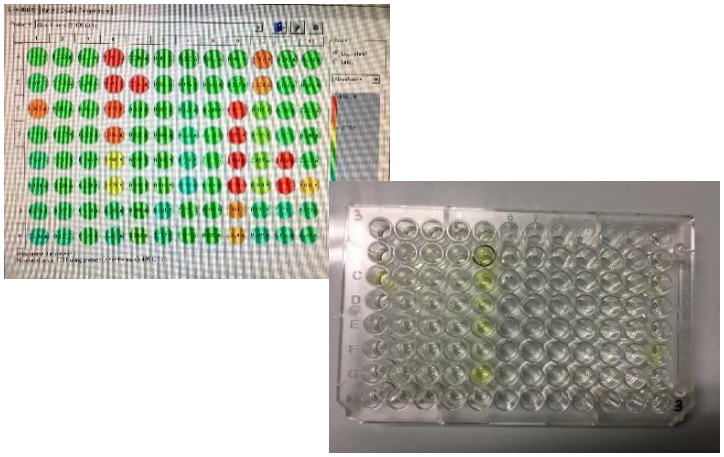
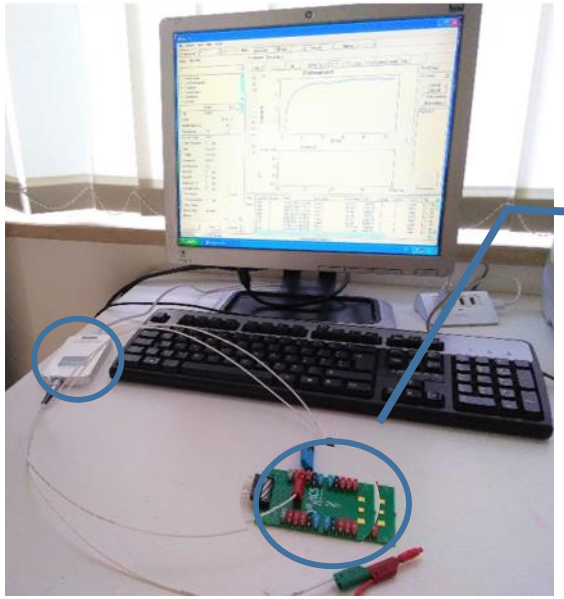
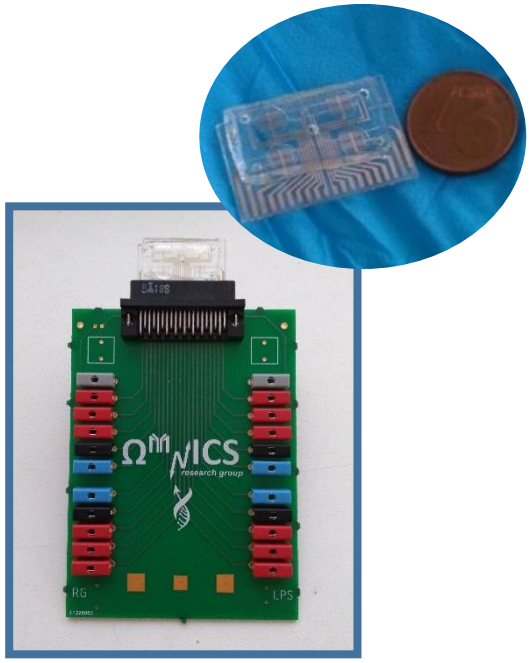
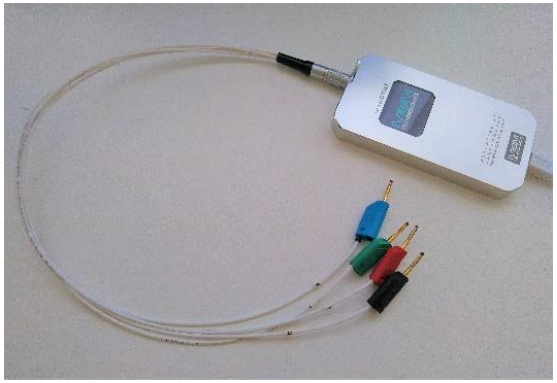
ELISA TEST



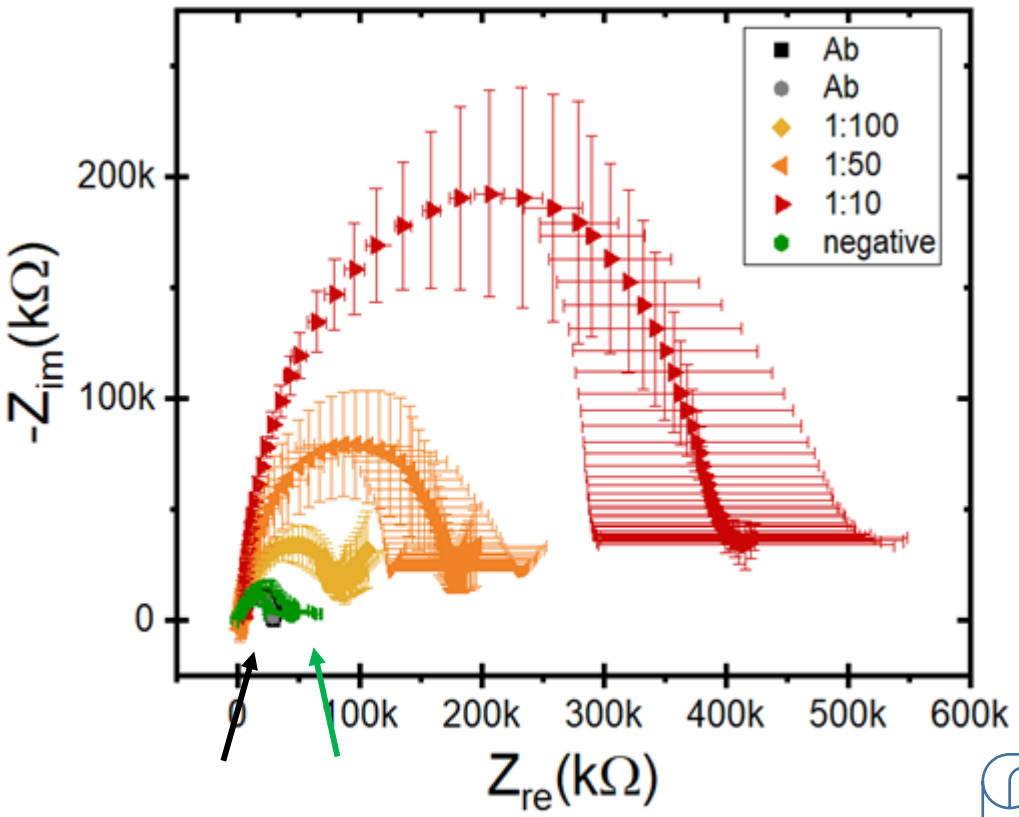
LOC







Results and discussion



The electron transfer resistance is about 40 kΩ after immobilization of the GLRaV-3 antibody and healthy sample.

ELISA test

Sample dilution	LOC	ELISA
1:3	+	(+)
1:5	+	(+)
1:10	+	-
1:20	+	-
1:50	+	-
1:100	(+)	-
1:1000	-	-

CURRENT DETECTION METHODS

Blouin, A. *et al.*, 2017;
Rowhani, A. *et al.*, 2017;
Bendel *et al.*, 2020.

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Conclusions

- **LOC devices shows higher sensitivity compared to ELISA test.**

- **This device can be competitive with conventional diagnostic methods for costs and portability, making the difference in real time detection of the pathogens.**

- **Due to its ease of use, sensibility and specificity, is possible to extend its application, for the detection of other viruses.**

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THANKS FOR
YOUR ATTENTION!

Supplementary Materials

Links:

- Maree, H. J.; Almeida, R. P. P.; Bester, R.; Chooi, K. M.; Cohen, D.; Dolja, V. V.; Fuchs, M. F.; Golino, D. A.; Jooste, A. E. C.; Martelli, G. P.; Naidu, R. A.; Rowhani, A.; Saldarelli, P.; Burger, J. Grapevine Leafroll-Associated Virus 3. *Front. Microbiol.* **2013**, *4*. https://doi.org/10.3389/fmicb.2013.00082.

- Scagliusi, S. M. M.; Vega, J.; Kuniyuki, H. Cytopathology of Callus Cells Infected with Grapevine Leafroll-Associated Virus 3. *Fitopatologia Brasileira* **2002**, *27* (4), 384–388. https://doi.org/10.1590/S0100-41582002000400008.

- Atallah, S. S.; Gómez, M. I.; Fuchs, M. F.; Martinson, T. E. Economic Impact of Grapevine Leafroll Disease on Vitis Vinifera Cv. Cabernet Franc in Finger Lakes Vineyards of New York. *Am J Enol Vitic.* **2012**, *63* (1), 73–79. https://doi.org/10.5344/ajev.2011.11055.

- Buja, I.; Sabella, E.; Monteduro, A. G.; Chiriacò, M. S.; De Bellis, L.; Luvisi, A.; Maruccio, G. Advances in Plant Disease Detection and Monitoring: From Traditional Assays to In-Field Diagnostics. *Sensors* **2021**, *21* (6), 2129. https://doi.org/10.3390/s21062129.

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Supplementary Materials

Links:

- Blouin, A. G.; Chooi, K. M.; Cohen, D.; MacDiarmid, R. M. Serological Methods for the Detection of Major Grapevine Viruses. In *Grapevine Viruses: Molecular Biology, Diagnostics and Management*; Meng, B., Martelli, G. P., Golino, D. A., Fuchs, M., Eds.; Springer International Publishing: Cham, 2017; pp 409–429. https://doi.org/10.1007/978-3-319-57706-7_21.

- Rowhani, A.; Osman, F.; Daubert, S. D.; Al Rwahnih, M.; Saldarelli, P. Polymerase Chain Reaction Methods for the Detection of Grapevine Viruses and Viroids. In *Grapevine Viruses: Molecular Biology, Diagnostics and Management*; Meng, B., Martelli, G. P., Golino, D. A., Fuchs, M., Eds.; Springer International Publishing: Cham, 2017; pp 431–450. https://doi.org/10.1007/978-3-319-57706-7_22.

- Bendel, N.; Kicherer, A.; Backhaus, A.; Köckerling, J.; Maixner, M.; Bleser, E.; Klück, H.-C.; Seiffert, U.; Voegele, R. T.; Töpfer, R. Detection of Grapevine Leafroll-Associated Virus 1 and 3 in White and Red Grapevine Cultivars Using Hyperspectral Imaging. *Remote Sensing* **2020**, *12* (10), 1693. https://doi.org/10.3390/rs12101693.

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