Tool for pesticide detection based on Lateral Flow Device

Deliverable D2.4

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B-GOOD

Giving Beekeeping Guidance by cOmputatiOnal-assisted Decision making

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Preface

In Task 2.4, Lateral Flow Devices for pesticide detection (M1-M18) will be developed, validated and implemented on matrices relevant in the bee environment. For demonstrator purposes a dual-channel lateral flow device (LFD) for the detection of neonicotinoids was selected due to its high TRL at the start of the B-GOOD project. As envisioned in Task 2.4, the high TRL provided for an early validation on relevant bee-related matrices and the subsequent introduction of this LFD at the point of need. Therefore the neonicotinoid LFD is the perfect demonstrator for deliverable D2.4, a tool for pesticide detection based on Lateral Flow Device.

Demonstrator outline

For deliverable 2.4, we decided to use the neonicotinoid lateral flow device (LFD), based on competitive immunoassays, as the most reliable tool for demonstration of the technology. This was based on its high TRL and its successful validation at the early stages of the B-GOOD project. For demonstration purposes, an instruction video with a running time of 10 minutes was shot at the Wageningen Food Safety Research (WFSR) laboratory (at partner WR). In this video the principle and the application of the dual-channel neonicotinoid LFD initially are demonstrated by the application of a tap water sample. This shows the development of a control line (which certifies that the LFD is performing according to standard) and a test line (which will develop in case of the absence of neonicotinoids). The explanation of the test line is crucial to avoid any confusion with the non-competitive formats of the now well-known pregnancy and covid LFD tests. Next to the control water sample, matrices relevant to bees are introduced as test models for the neonicotinoids, e.g. pollen, honey and rapeseed plant material. The easy straightforward extraction of these matrices, by just adding boiling water, are demonstrated. While in the demonstration video a professional lab weighing scale is used, the video mentions that a simple kitchen-scale can easily be implemented. Additionally, the boiled/hot water may be brought to the point of need using a thermo bottle. Crucial for the LFD test presented is the advice to let the extracts cool down to room temperature before applying them in the strip test, as hot extracts will degenerate the bio-molecules in the LFD. Results demonstrated in the video, show that from the 6 samples analysed with the LFD, 2 are contaminated with neonicotinoids. One being an environmentally contaminated pollen sample (with acetamiprid) and one being a fortified rapeseed sample (with imidacloprid). In the concluding statement it is mentioned that even though the LFD is developed for the detection of imidacloprid and acetamiprid,it has essential cross-reactivity with clothianidin, thiacloprid, nitenpyram and imidaclothiz. The corresponding video was published on the B-GOOD website and youtube channel as well as the B-GOOD social network channels. The schematic layout of the video can be seen in Figure 1. Additionally, the video was an integral part of the Multi-actor Forum workshop reported in Deliverable D8.3. A second demonstrator video, explaining the LFD preparation and testing workflow was shot and placed online. A third video shows the general progress in Task 2.4 considering the development of the pesticide LFDs.

1. Lateral flow device for neonicotinoid contamination screening (demonstrator video)

https://www.youtube.com/watch?v=eZQQakPxEFE

2. Preparation of LFDs by WFSR (demonstrator video)
https://www.youtube.com/watch?v=efcLKoeiqDc

3. CM5: LFD Optimisation & Task 2.4 progress (progress update video)
https://www.youtube.com/watch?v=9TA_pIH2RRk

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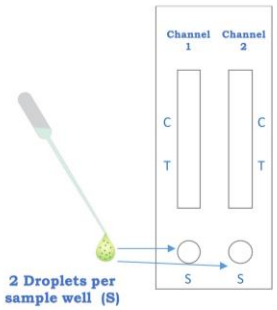
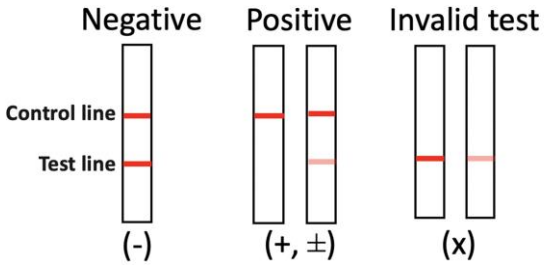
Lateral flow device for neonicotinoid contamination screening



1. Application of samples to the neonicotinoids LFD

2. Let test develop for 10 minutes before visual readout



3. Read results of the LFD in both channels

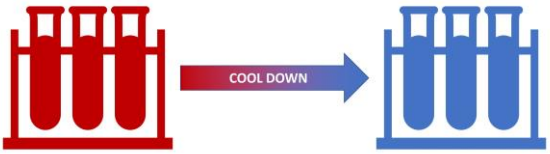
1 gram (g) material

+

10 millilitre (ml)

boiling tap water

4. Prepare extracts from pollen, honey and rapeseed with boiling water



5. Cool down extracts to room temperature and add sample to LFD, read results

Neonicotinoid	Recognition (at 100 ppb)	Channel
Imidacloprid	Yes	1
Clothianidin	Yes	1
Nitenpyram	Yes	1
Imidaclothiz	Yes	1
Acetamiprid	Yes	2
Thiacloprid	Yes	1&2
Thiamethoxam	No	-
Dinotefuran	No	-

6. Reactivity and cross-reactivity of the neonicotinoids in the presented LFD

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Figure 1. Storyline of the demonstrator video *"lateral flow device for neonicotinoid contamination screening".*

Due to the covid pandemic, on-site demonstrators at partner and/or end user facilities were unfortunately not feasible due to national and European travel and visiting regulations. However to demonstrate the ease of use by non-skilled personnel, WFSR has organized an

on-line demonstrator workshop for the partners in the B-GOOD project. To this end, LFDs and anonymized blank- and fortified pollen samples were distributed to the partners in advance. The partners only needed to provide a water boiler and were mostly preforming the tests at their homes. The aforementioned demonstration video was also an integral part of this online workshop. A screenshot of the participants to the on-line demonstrator can be seen in Figure 2.

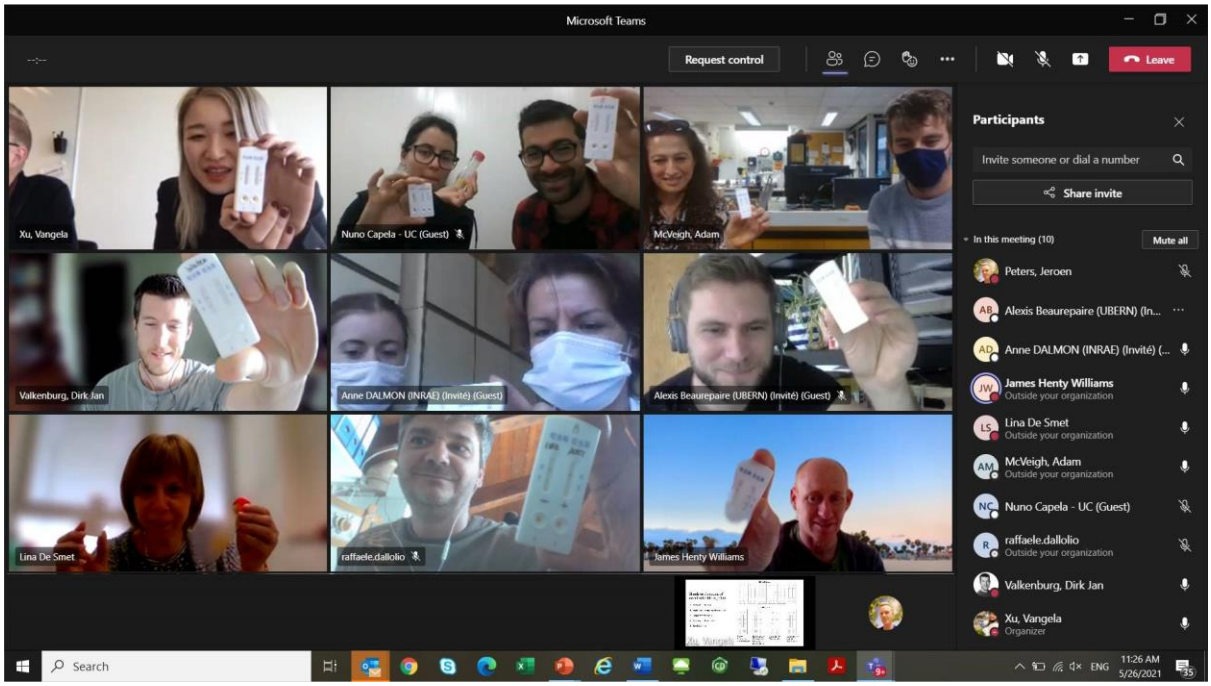

Figure 2. Presentation of the results from the “do it yourself” LFD application demonstrator workshop

Conclusion

The LFD application demonstrator video shows that the neonicotinoid LFD provides for easy and rapid detection of neonicotinoids in bee-related matrices in a simple laboratory set-up. At the same time it becomes clear that its simplicity and the corresponding sample preparation allows the easy implementation at the point of need.

Outlook

The current neonicotinoids LFD is still a non-commercial prototype that is developed by WFSR partner Zhejiang University (ZJU). Based on the validation studies, WFSR has advised ZJU to introduce some important improvements to the LFD (e.g. line intensities and prolonged storability). These have been implemented successfully. For the moment commercialization of the LFD is not yet considered as a market study should first shed some light of the envisioned production scale. Until then, WFSR can provide the improved prototype LFDs at a research price for scientific and monitoring studies. Monitoring for acetamiprid within the B-GOOD project was already carried out in the field. At this moment the LFD is even a 3 channel test, that now is also capable of sensitively detecting thiamethoxam.