Early detection of Tetranychus urticae in tomato soilless culture using electrophysiology and supervised machine learning

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Introduction

- ❑ Electrical signaling is a widely conserved process in life kingdom to rapidly transmit information in response to physiological perturbations
- ❑ PhytlSigns sensor enabling real-time bioelectrical signal measurements in commercial greenhouse[1]
- ❑ Spider mite represents a major pest for greenhouse crop. With a short life cycle, it spread rapidly during summer season and cause crop damages

Objective

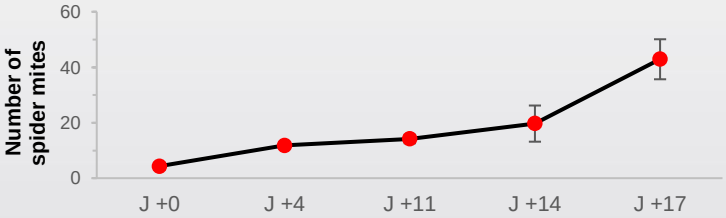
- ❑ Does electrophysiological biosensor can help to early detect spider mite infestation?

Experimental set-up

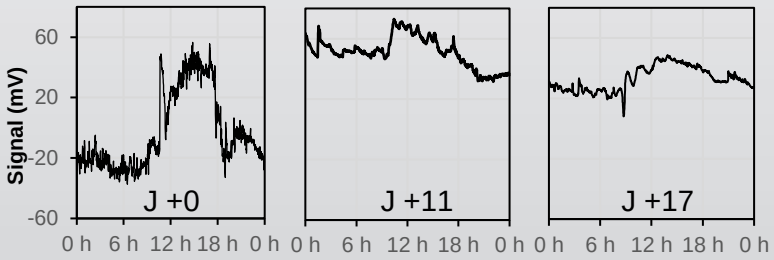
- From July to September 2019 at field station of Agroscope Conthey (Switzerland)
- 90 m² glasshouse equipped with lateral and roof ventilations, fogging and shading
- 16 experimental cages enclosed in a fine nylon mesh (diameter = 250 µm) on all sides (1.75 × 1.75 × 2.5 m) in latin square split-plot design with 4 cages x 4 treatments x 4 replicates
- Three 50-days old tomato plant (*S. lycopersicum L.* cv. Admiro) in each cage
- *Tetranychus urticae* were reared on tomato plants (*S. lycopersicum L.* cv. Admiro)
- PhytlSigns sensor (Vivent SA, CH)

Results

Spider mites infestation evolution



Daily bioelectrical evolution



Modelling

238 features extracted from bioelectrical signal

Supervised machine learning using Gradient Boosted trees[2]

Features	Accuracy (%)	Precision (%)	Specificity (%)
Original	80.0	80.8	81.1
Reduced	79.9	83.8	85.6

Conclusion

Modification of bioelectrical signal is induced in response to spider mites infestion in tomato plants.

Modelling the bioelectrical signal allows early prediction.

[1] Tran et al., Sci. Rep. 2019; 9:17073; [2] Najdenovska et al., (under review)

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