Agricultural Institute of Slovenia

ILVO
Institute for Agricultural and Fisheries Research

efsa
European Food Safety Authority

NemDetect

Early detection of quarantine nematodes in potatoes using remote sensing

GP/EFSA/ALPHA/2018/02

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Root-knot and potato cyst nematodes

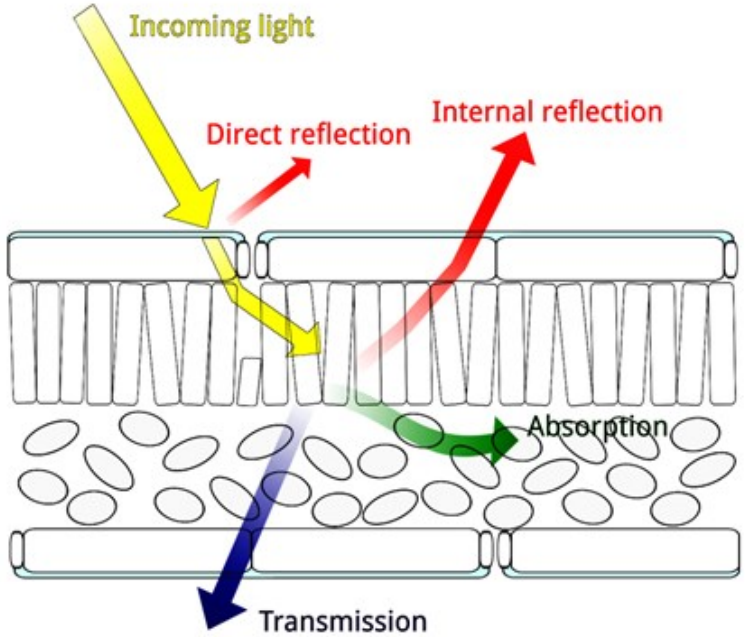
Meloidogyne chitwoodi & M. fallax

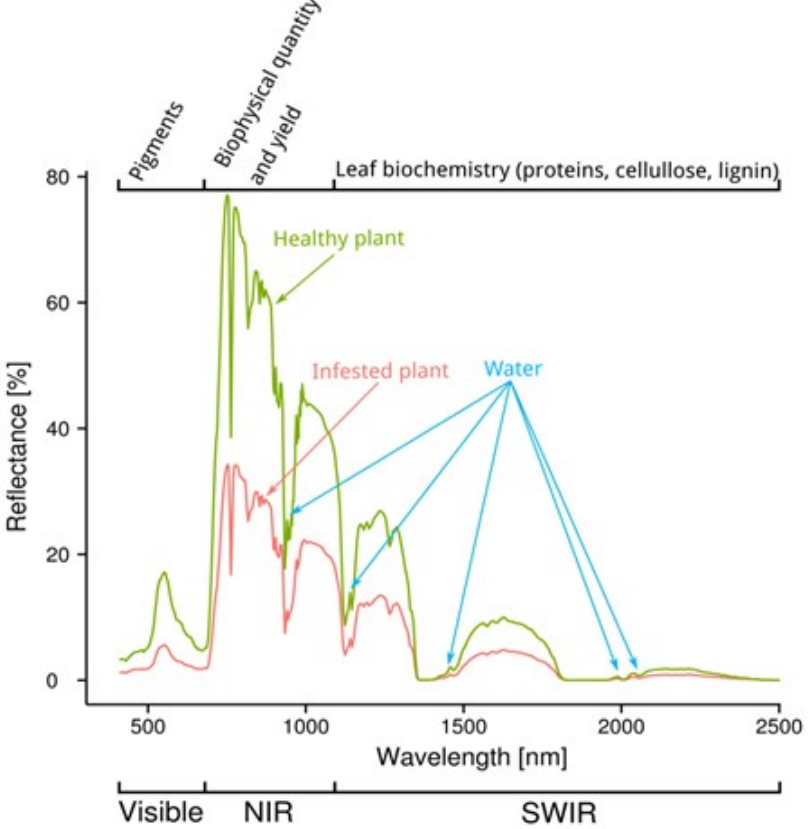
Globodera pallida & G. rostochiensis

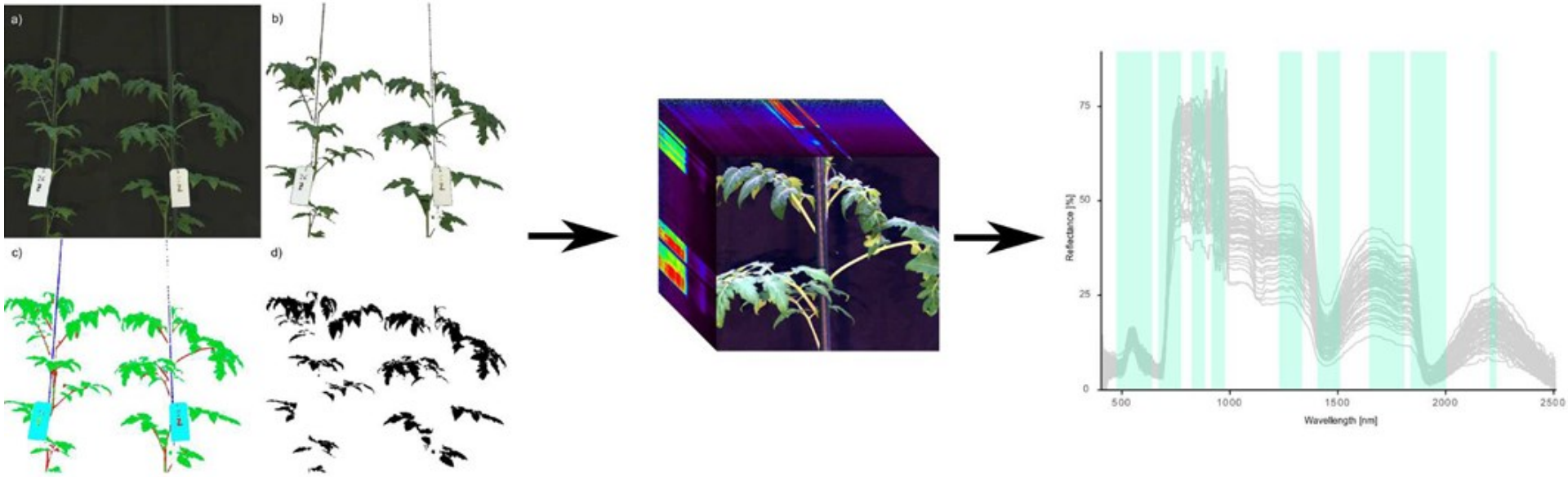
- Annex I A II and on the EPPO A2 list of pests recommended for regulation
- Endoparasites that infest and become sedentary in the root system
- Overall weakening of the host plants due to reduced uptake of water and nutrients
- RKNs – additional damage on potato tubers
- Infestation symptoms on the canopy is non-specific and similar to the signs of drought

Why remote sensing?

- Visible symptoms identical to drought stress
- Accurate detection by uprooting and visually checking roots
- Time consuming
- Not feasible on large areas


Incoming light
Direct reflection
Internal reflection
Absorption
Transmission

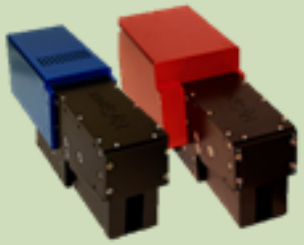

Pigments
Biophysical quantity and yield
Leaf biochemistry (proteins, cellullose, lignin)
Healthy plant
Infested plant
Water
Reflectance [%]
Wavelength [nm]
Visible
NIR
SWIR


a)
b)
c)
d)
Reflectance [%]
Wavelength [nm]

RS sensors

Hypespectral

Hyspex
VNIR-1600
SWIR-364



Mjolnir VS-620

Multispectral

Micasense
Rededge-MX

Thermal

FLIR Vue Pro
R

LiDAR

Riegl
miniVUX-2
UAV

Spectrometer & RGB

Oceanoptics
Flame

4k RGB
camera

RS platforms

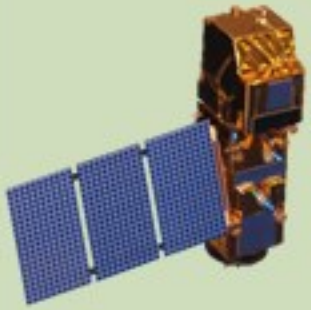
Lab & greenhouse

Field

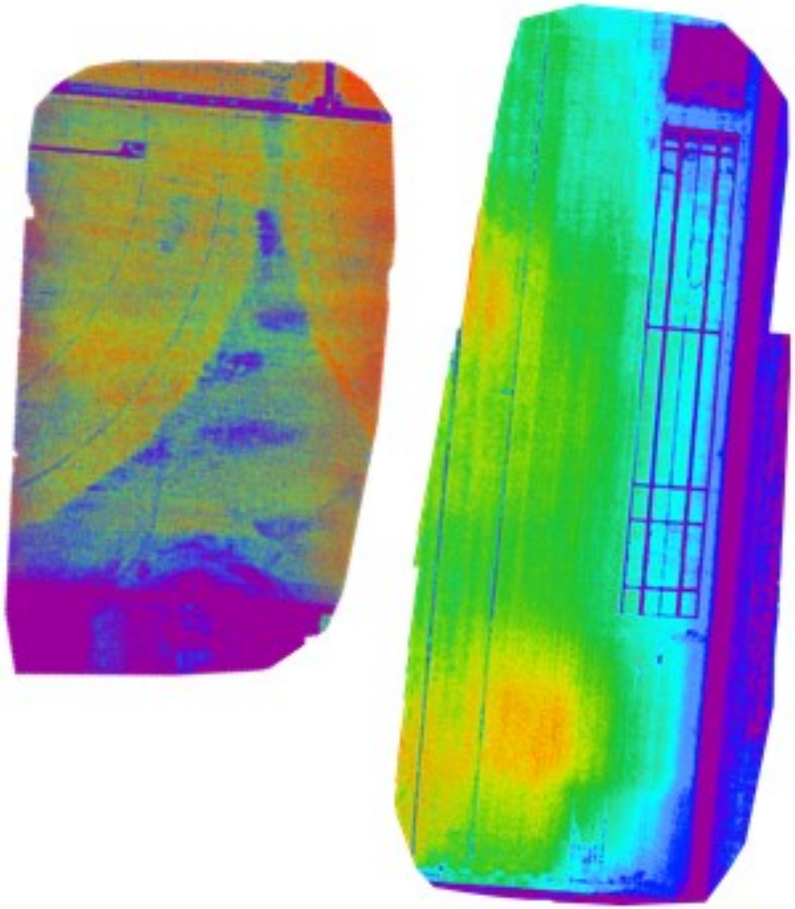
Airborne

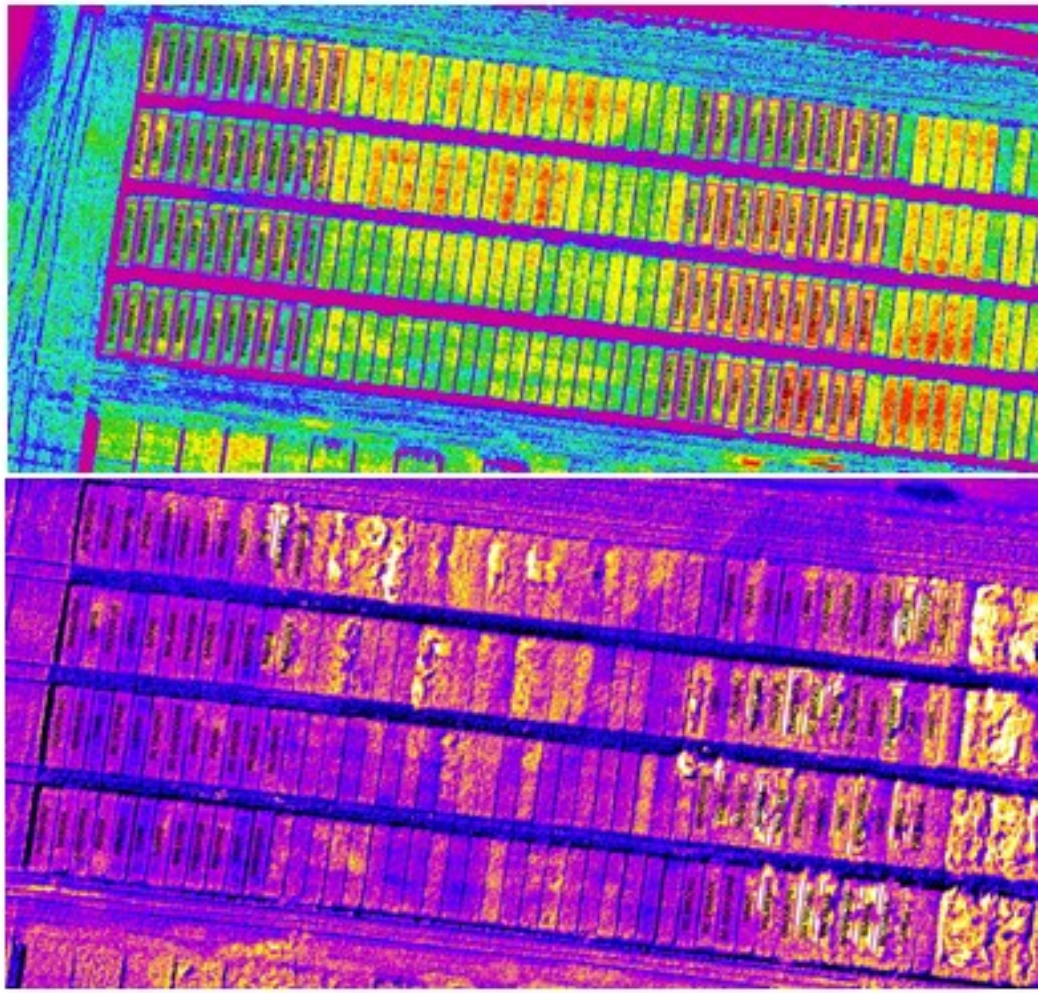
UAV

Satellite

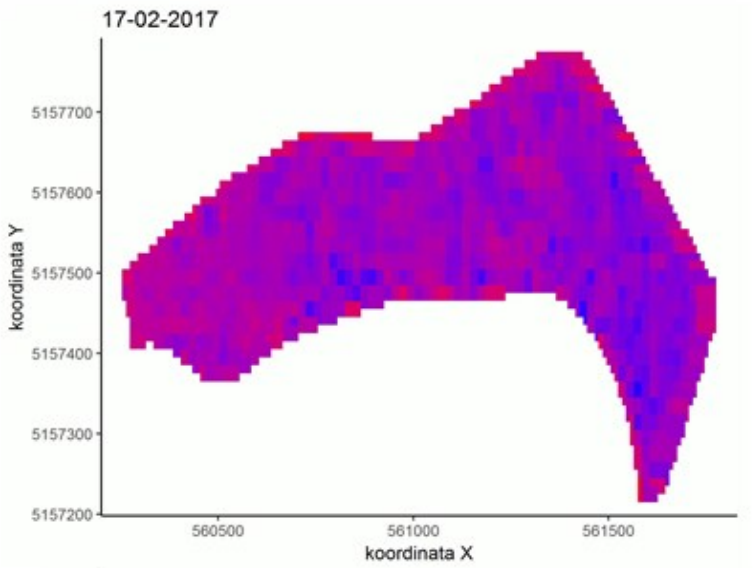


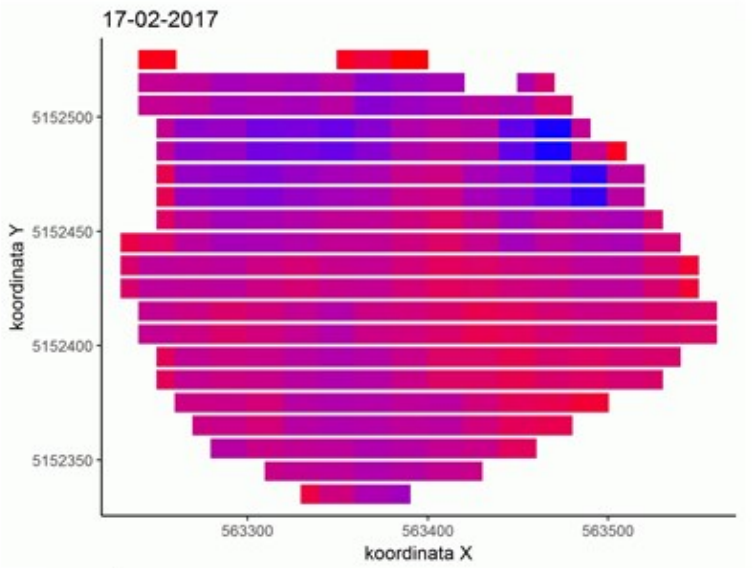
Heat maps

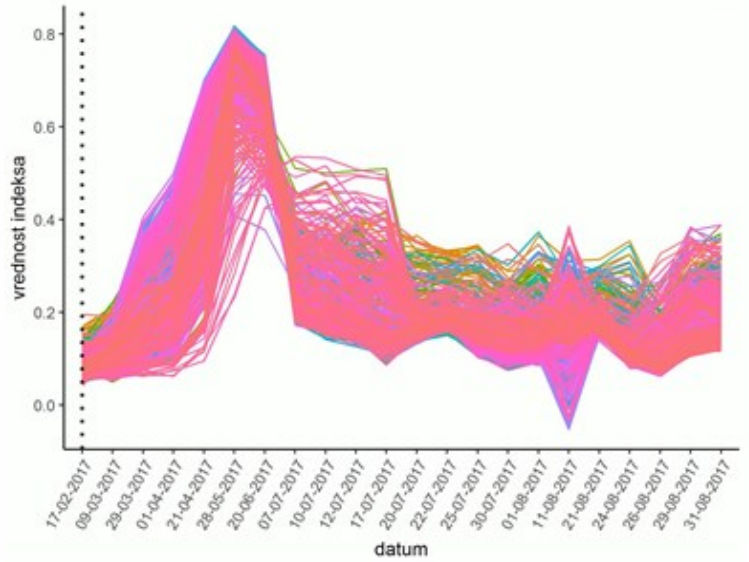


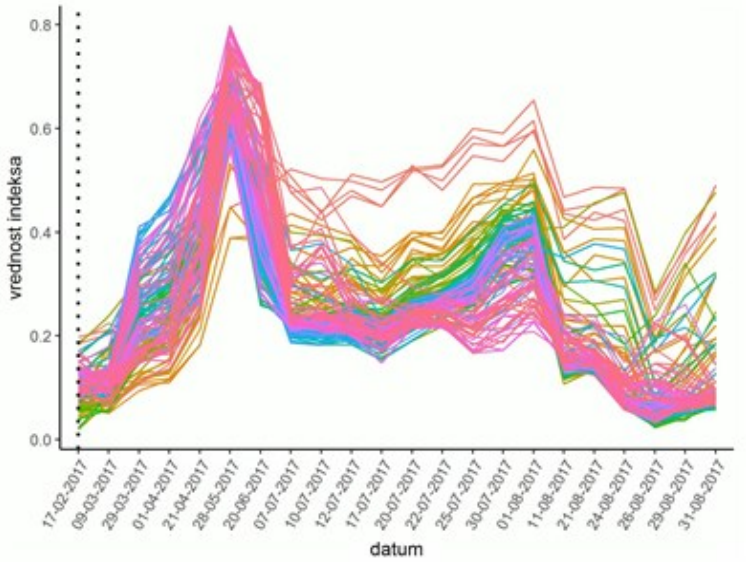


Time series data

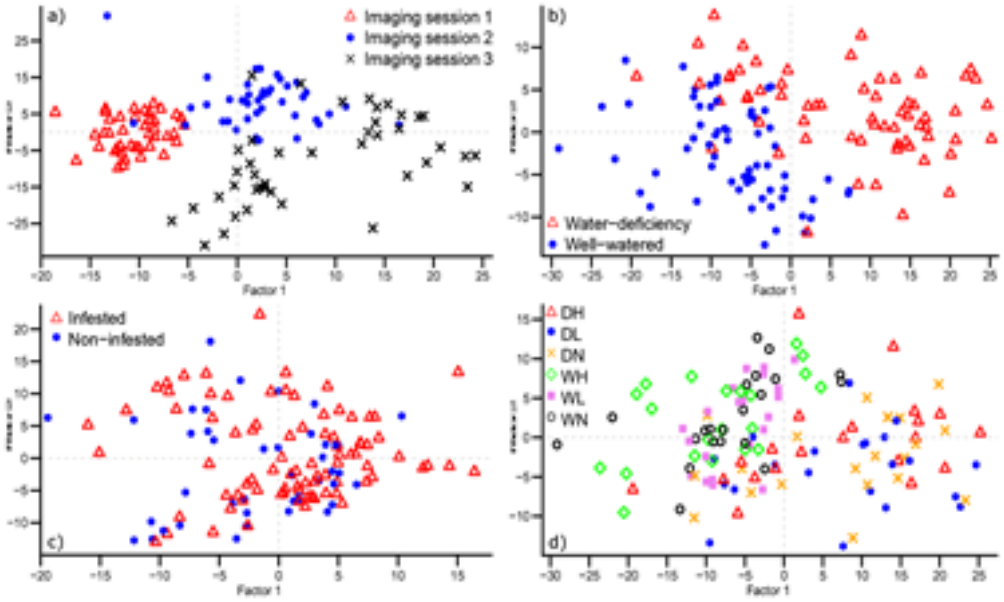








Nematode detection with RS



a)

	IS1	IS2	IS3
IS1	**42**		
IS2		**42**	
IS3			**42**

b)

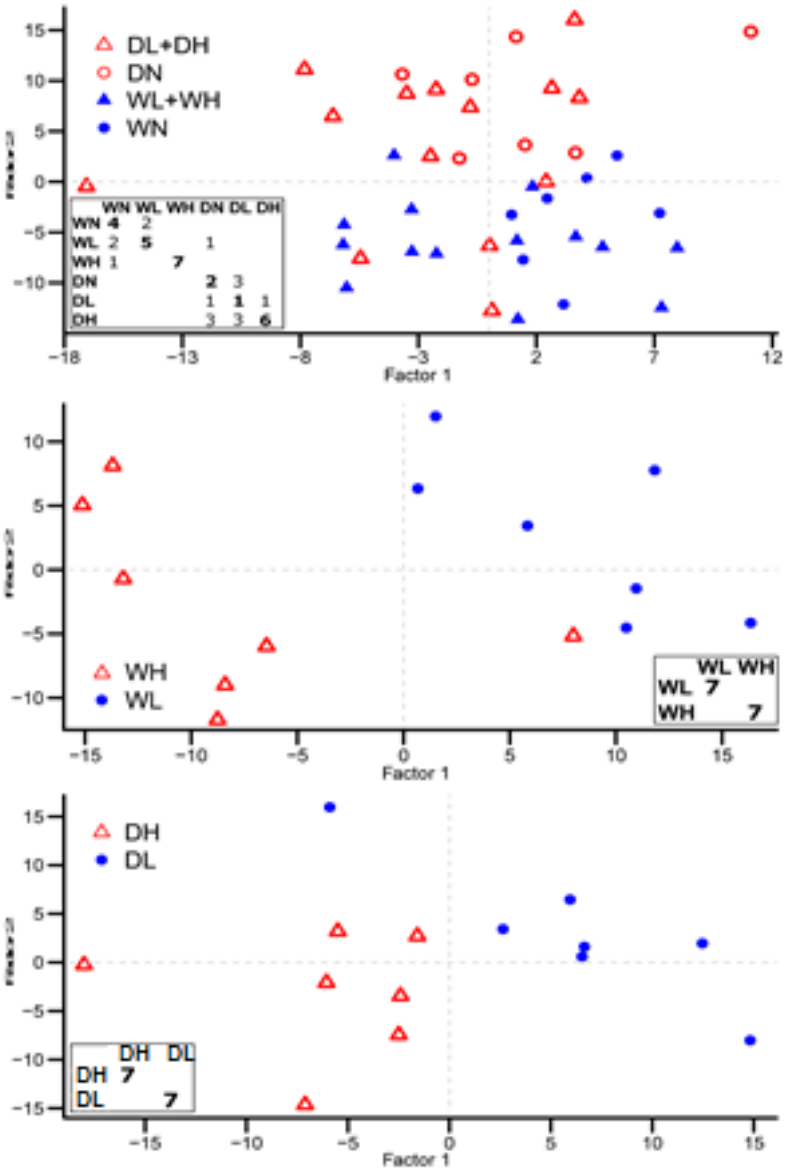
	WW	WD
WW	**61**	3
WD	2	**60**

c)

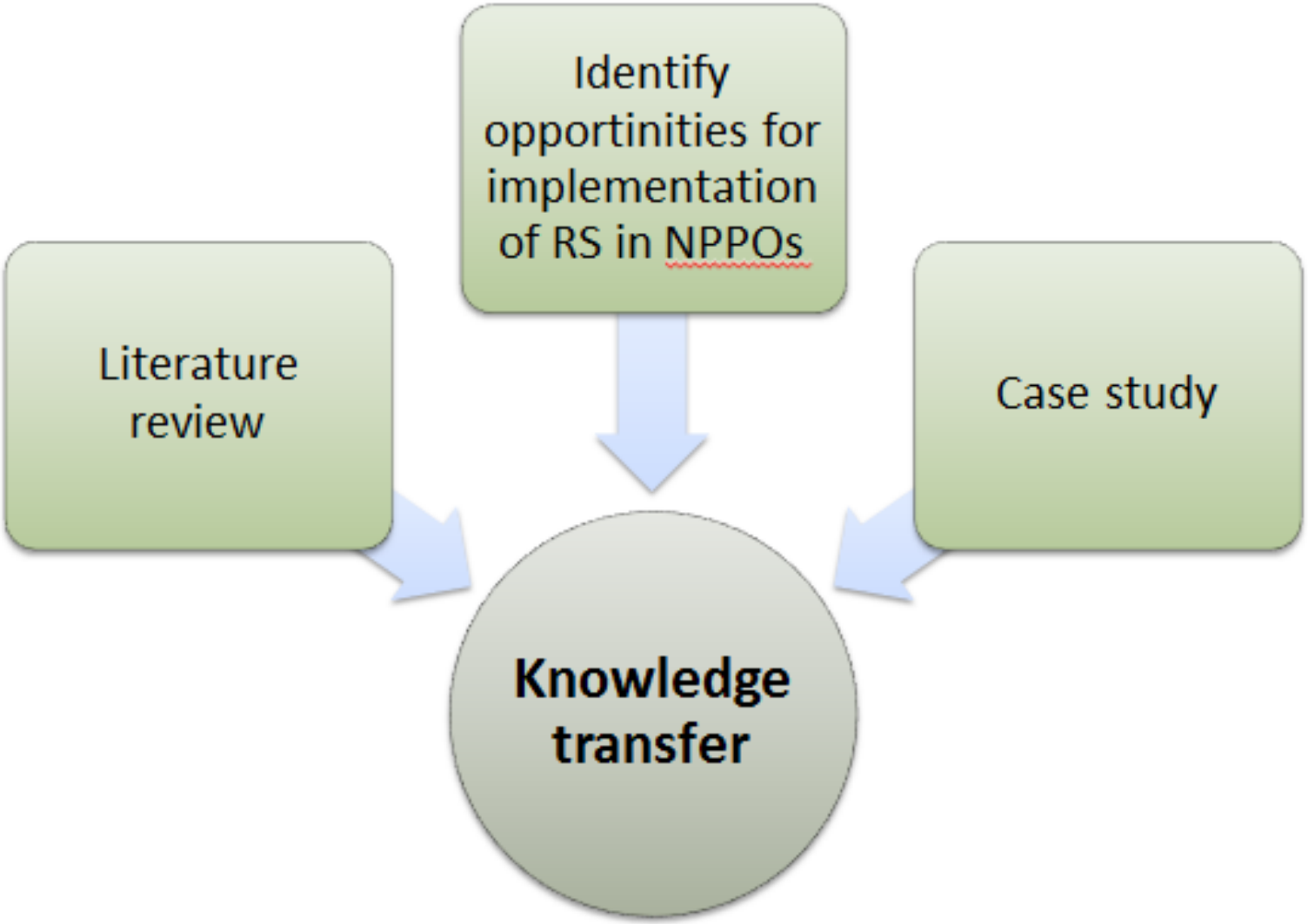
	WN	WL+WH
WN	**31**	2
WL+WH	11	**82**

d)

	WN	WL	WH	DN	DL	DH
WN	**9**	6	2		1	2
WL	7	**12**		1		1
WH	4	3	**19**	2	2	2
DN				**8**	6	12
DL	1			1	**3**	3
DH				9	9	**1**



Project structure



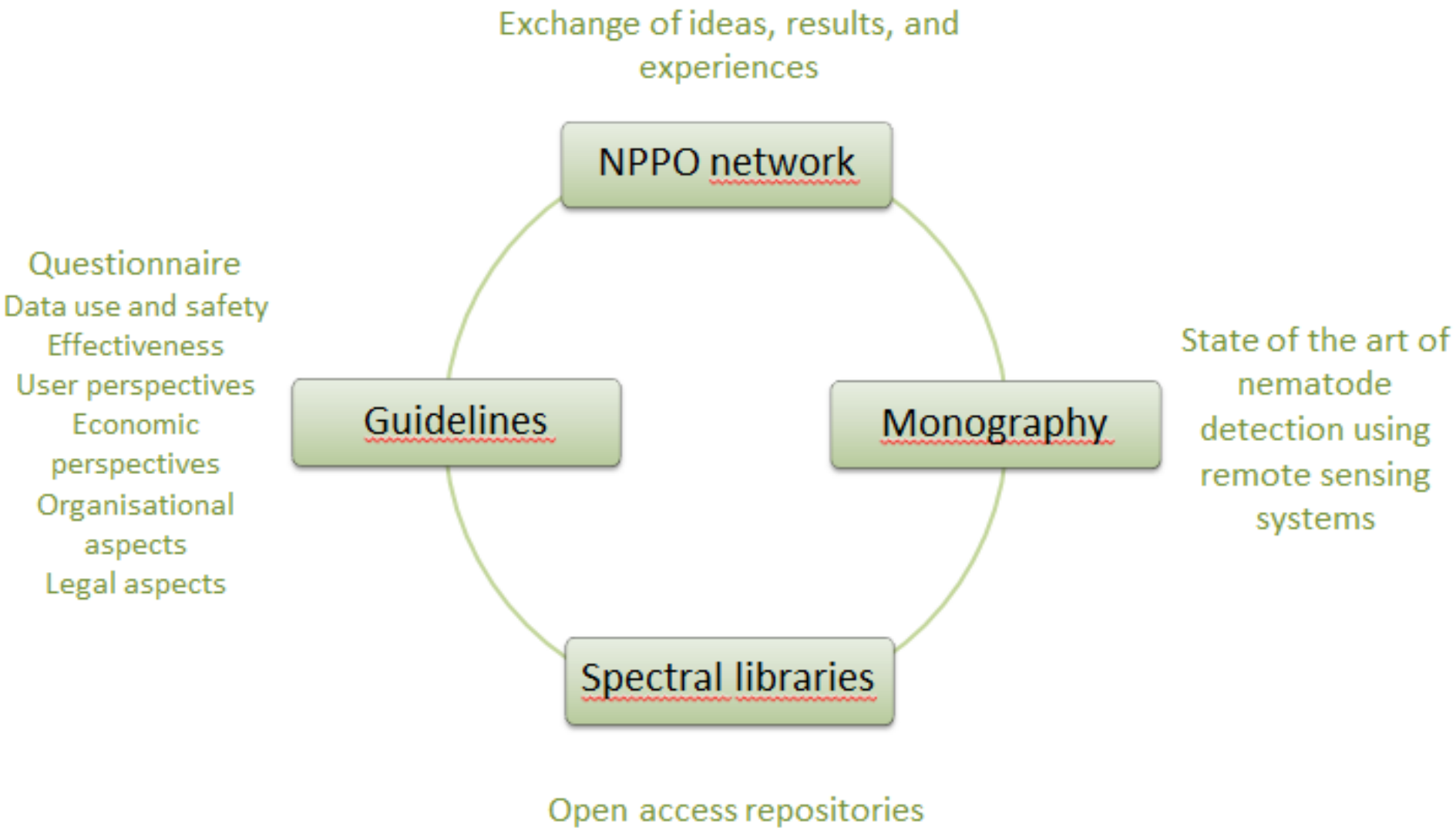
1. Literature review

- Žibrat et al. 2019. Plant pests and disease detection using optical sensors. *Folia biologica et geologica* 60(2)*:* 41-52

- Žibrat et al. 2020. Chapter 26: Non-invasive Detection of Plant Parasitic Nematodes using Hyperspectral and other Remote Sensing Systems. In: Pandey et al. (Eds) 2019: Hyperspectral Remote Sensing: Theory & Applications. Elsevier, ISBN: 978-0-08-102894-0

- Summary review available on EFSA project websites

2. Identify opportunities of implementation

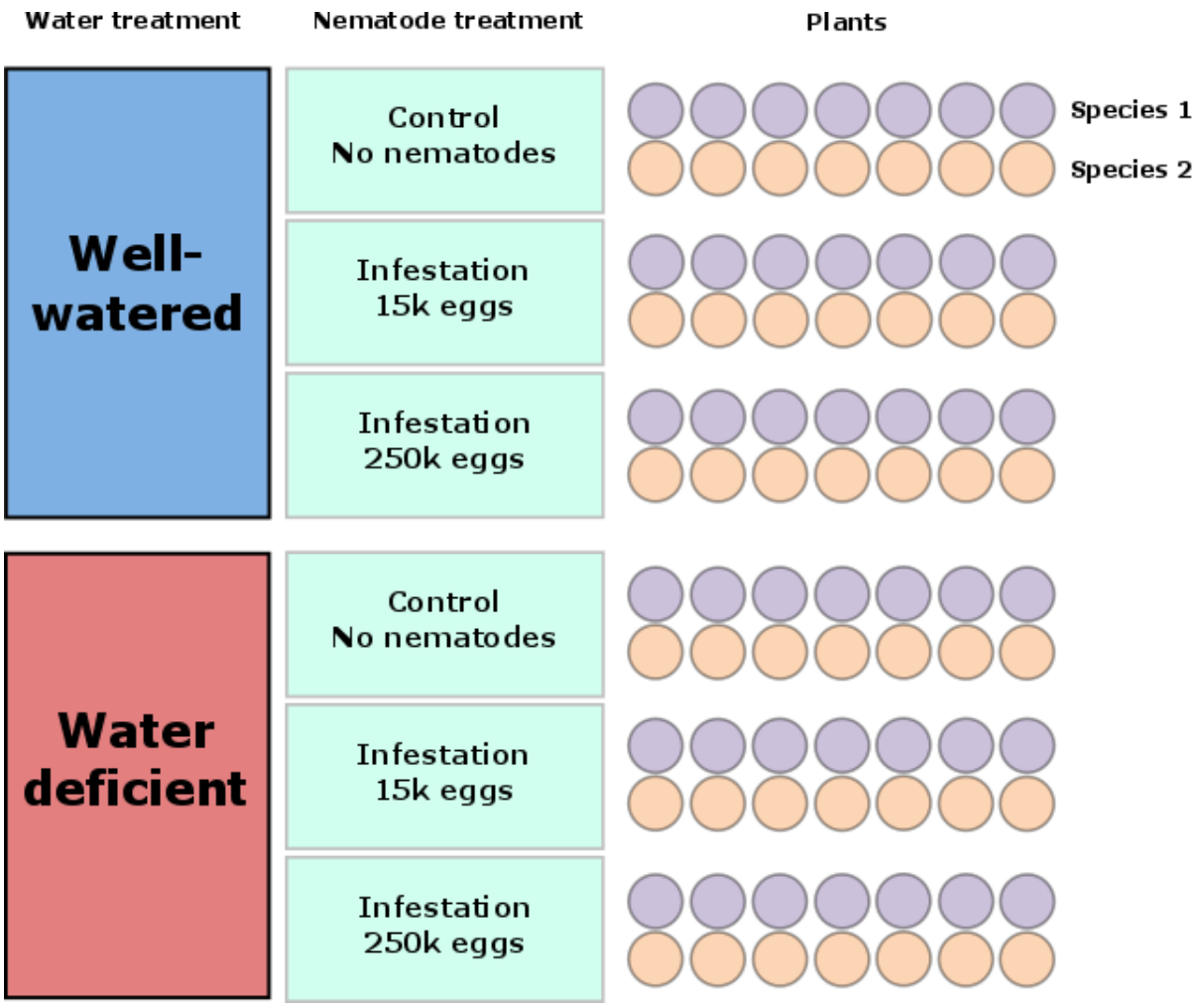


3. Case study

M. chitwoodi & *M. fallax* + *G. pallida* & *G. rostochiensis* + drought stress

Multispectral, hyperspectral, thermal + physiology

3 spatial levels (tubers, pot/microplot, field level) Mobile platform, UAV, airplane



4. Knowledge transfer

NPPO seminars | Workshops | Leaflet | Brochure

- Opportunities for scientific cooperation and research and the challenges of the revised General Food Law in the areas of activity of the European Food Safety Authority. EFSA Focal Point, Ministry of Agriculture, Forestry and Food
- Consultation of the Public Agricultural Advisory Service and the European Innovation Partnership Event – EIP
- Traditional AGRA international agri-food fair
- Together for progress of Slovenian agriculture and rural development. 34. Traditional consultation of agricultural public service

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Thank you.

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