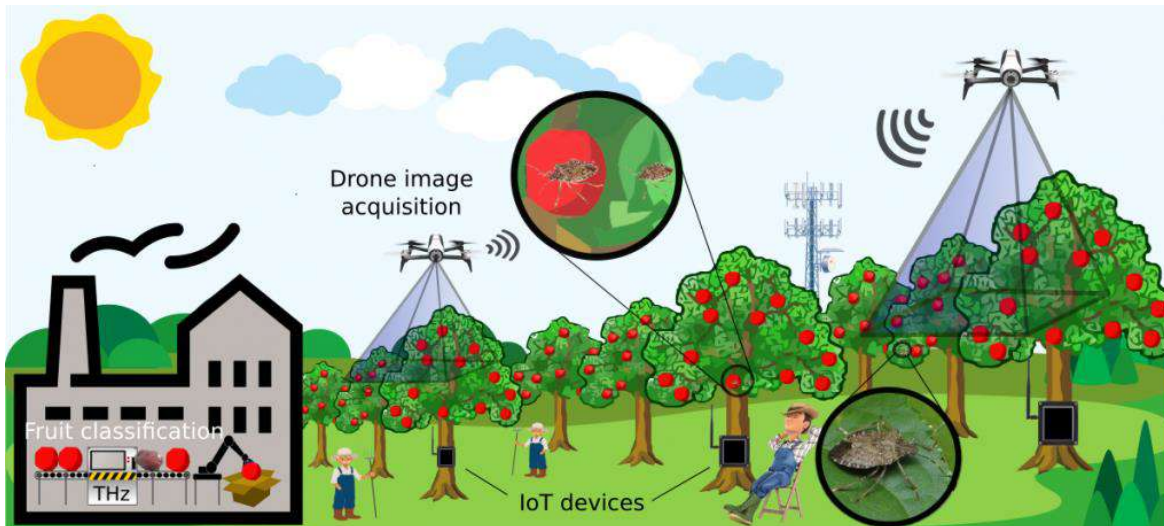


# Monitoring of insect pests in crop fields using spectral imaging

Rosalba Calvini, Veronica Ferrari, Lara Maistrello, Alessandro Ulrici

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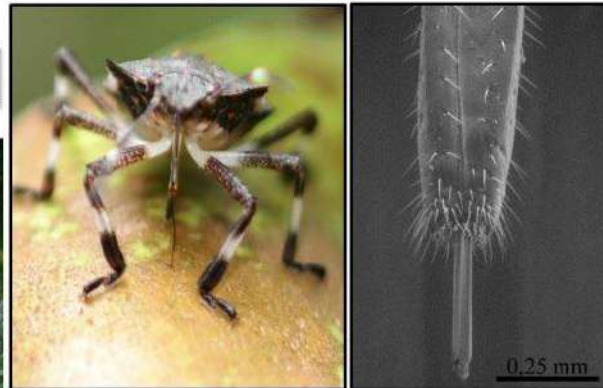
 **HALY.ID**  
HALYomorpha halys IDentification



HALYomorpha halys IDentification


*Innovative ICT tools for targeted monitoring and sustainable management of the brown marmorated stink bug and other pests*

**Halyomorpha halys and its stylet**



**Visible damage to fruits**



- Brown marmorated stink bug (*Halyomorpha halys*) has rapidly spread in Europe since 2004
  - Both adults and nymphs **feed by piercing and sucking** a great variety of **fruits and seeds**, causing **severe damages on crops**
  - Field monitoring of insect pests is fundamental to gain information about presence of pests and timely adopt proper actions
- 
- **Spectral cameras** mounted on Unmanned Aerial Vehicles (UAVs) or other Internet of Things (IoT) devices can be **used to improve crop field monitoring**

HALY.ID is part of ERA-NET Cofund ICT-AGRI-FOOD, with funding provided by national sources (Ministero delle politiche agricole e forestali, MIPAAF) and co-funding by the European Union's Horizon 2020 research and innovation program, Grant Agreement number 862671.

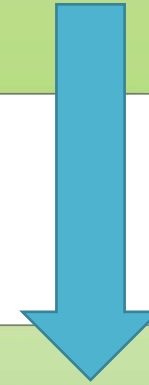


# HALY.ID

HALYomorpha halys IDentification



The **dark brown colour** of *H. halys* makes this bug **hardly detectable** with **RGB cameras** or **spectral cameras** based on the **visible range**, since it can be easily **confused with tree bark or dry leaves**



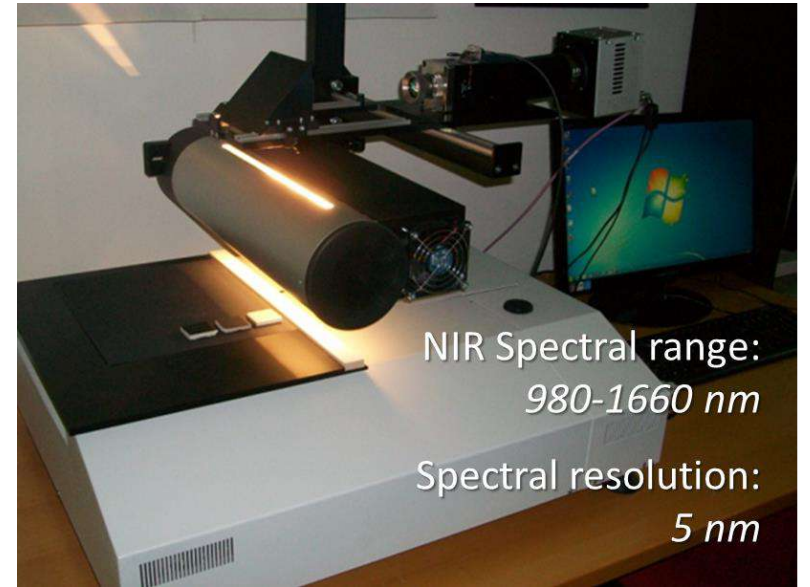
To **overcome the problem of mimicry** of *H. halys* and effectively detect the bugs in crop fields it is necessary to **move to cameras working in the NIR range**



# IMAGE ACQUISITION

NIR hyperspectral images of *H. halys* were acquired considering different background types to mimic a real field application scene:

- Green leaves
- Yellow leaves
- Brown leaves
- Grass
- Bark
- Tree branches
- Soil

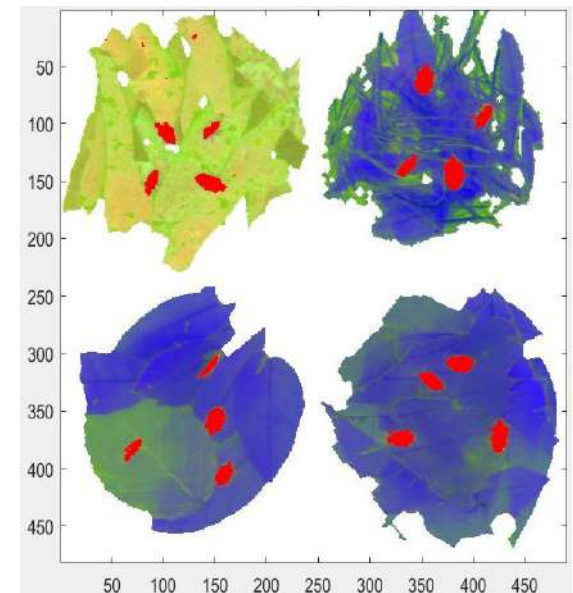
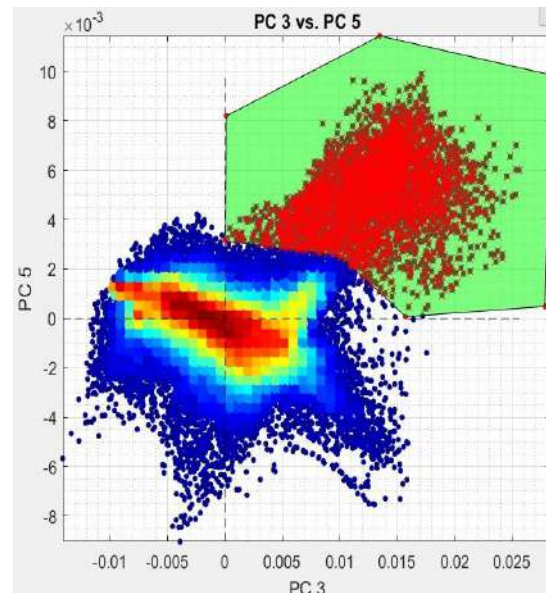
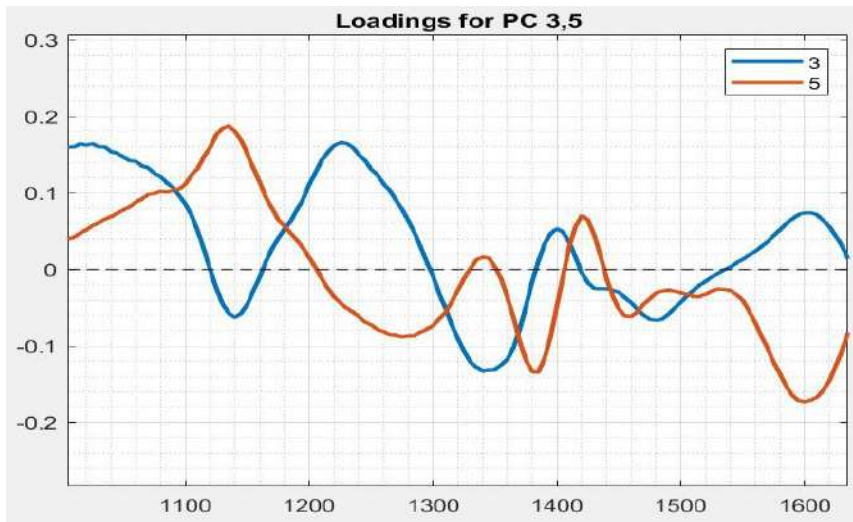
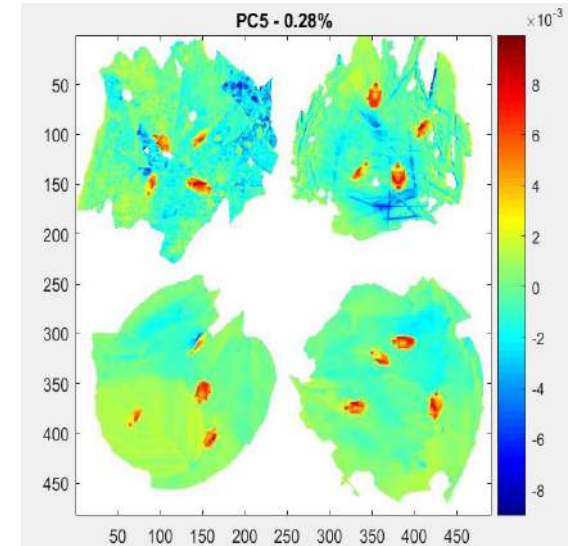
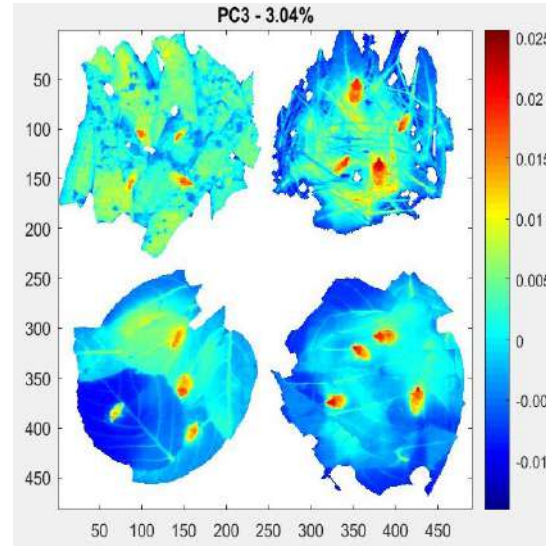


5 images with different  
bugs for each  
background type

35 hyperspectral  
images



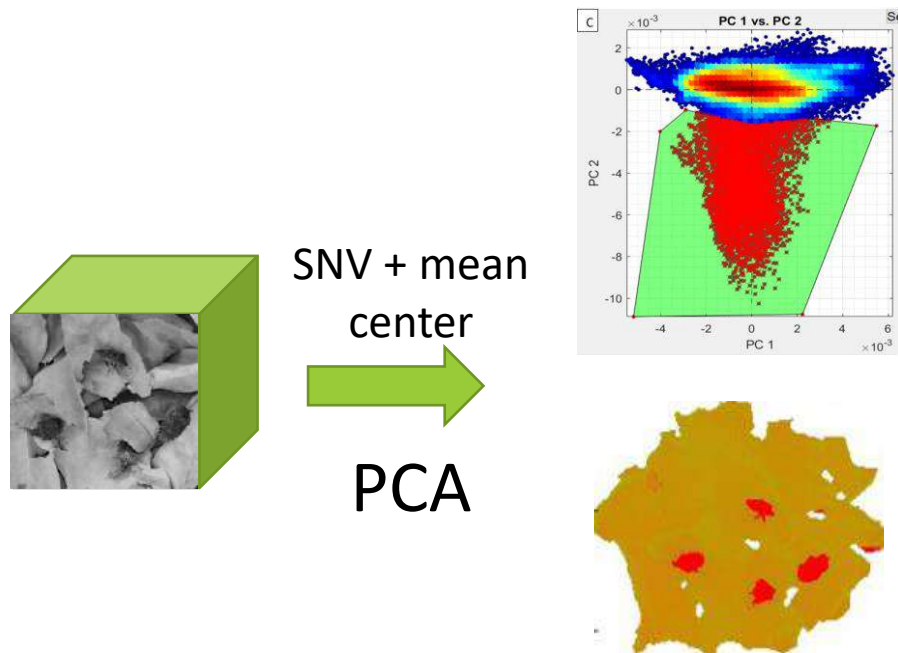
# EXPLORATORY IMAGE ANALYSIS (PCA)





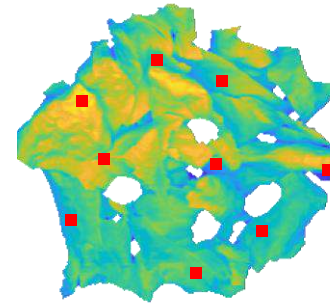
# CLASSIFICATION: *H. halys* vs BACKGROUND

**MASKING** to separate pixels  
belonging to bugs and background



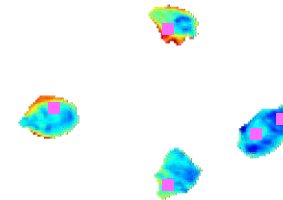
Mean center  
+ PCA

Background



*H. halys*

Mean center  
+ PCA



BACKGROUND

7000 spectra

→ from each image, 200  
spectra selected using  
Kennard-Stone algorithm on  
PCA scores

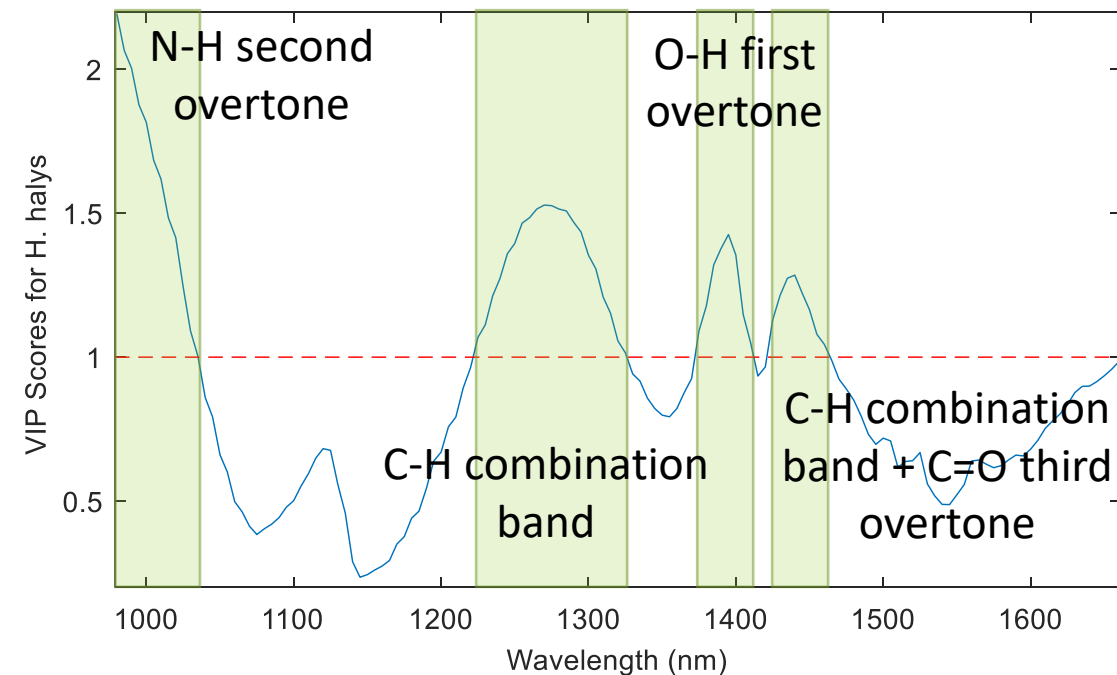
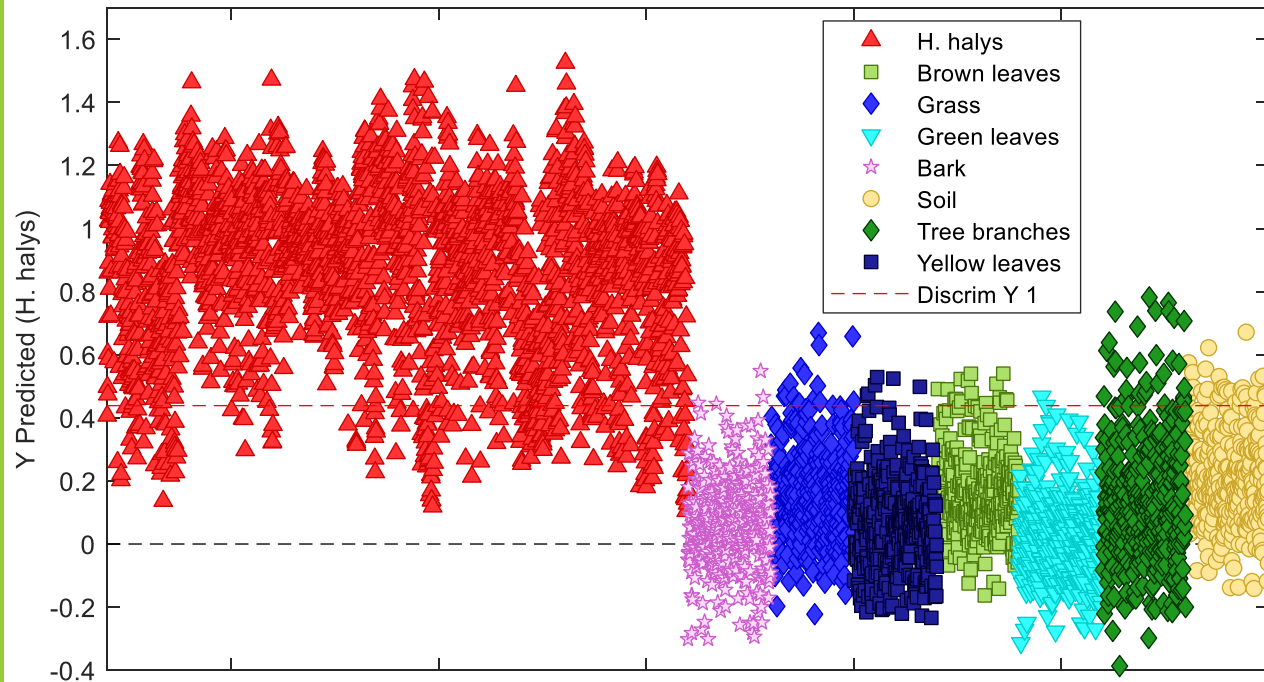
*H. halys*

7000 spectra

→ from each image, 200  
spectra selected using  
Kennard-Stone algorithm on  
PCA scores

# CLASSIFICATION: *H. halys* vs BACKGROUND

	Cross-validation	Prediction of external test set
<b>SENSITIVITY</b>	0.908	0.916
<b>SPECIFICITY</b>	0.959	0.962
<b>EFFICIENCY</b>	0.933	0.939

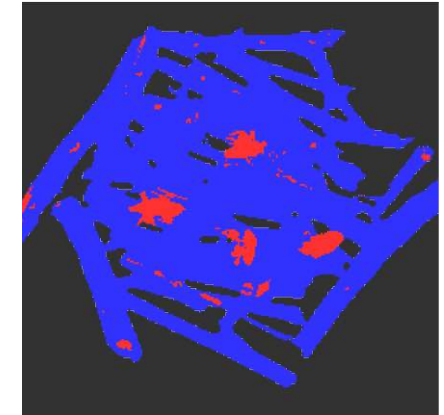
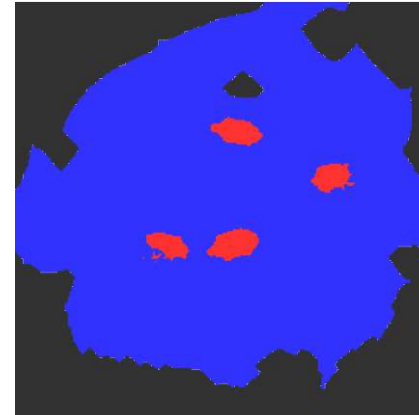
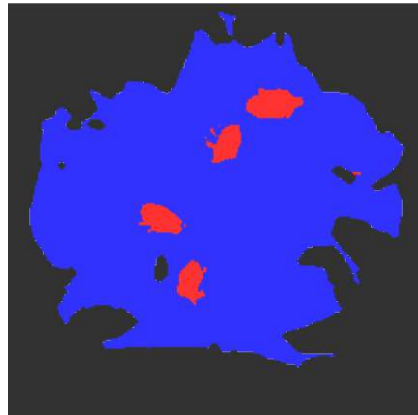
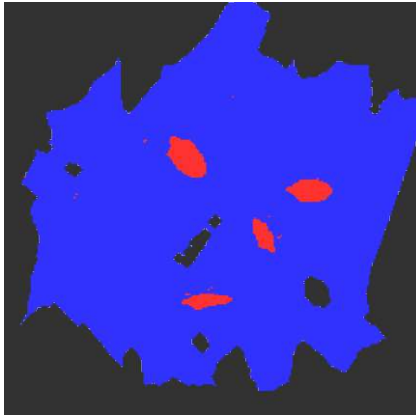


# CLASSIFICATION: *H. halys* vs BACKGROUND

■ Predicted as *H. halys*

■ Predicted as background

Prediction images  
of HSI data



BARK

BROWN LEAVES

GREEN LEAVES

TREE BRANCHES

RGB images





# CONCLUSIONS AND FUTURE PERSPECTIVES

- In this preliminary study we obtained satisfactory results in the discrimination between *H. halys* and different backgrounds using NIR-HSI.
- We also obtained useful information about relevant variables able to discriminate *H. halys* and backgrounds.
- Further steps will consist in the application of more refined classification and variable selection methods to automatically identify relevant spectral variables.
- Selected variables will be used to simulate a cheaper and faster multispectral imaging system starting from hyperspectral data

*Thank you for your  
attention*

REC

**Title :** Monitoring of insect pests in crop fields using spect

**Speaker :** Rosalba Salvini

**Institute :** University of Modena and Reggio Emilia, Italy



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*Halyomorpha halyis and its stylet*



- Brown marmorated stink bug (*Halyomorpha halyis*) has rapidly spread in Europe since 2004

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- Field monitoring of insect pests is fundamental to gain information about presence of pests and timely adopt proper actions

- Spectral cameras mounted on Unmanned Aerial Vehicles (UAVs) or other Internet of Things (IoT) devices can be used to improve field monitoring

The next winner is.

The 20th International Conference on NIR

**Best Poster Award**

Presented to

*Rosalba Salvini*

October 18-21, 2021  
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Prof. Hongfu Yuan  
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*Yuan Hongfu*