Grower Summary

SF 144

Early detection of stress in strawberry plants using hyperspectral image analysis

Annual 2016

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Further information

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Project title:	Early detection of stress in strawberry plants using hyperspectral image analysis
Project number:	SF 144
Project leader:	Andrew French, University of Nottingham Nicola Harrison, NIAB EMR
Report:	Annual report, May 2016
Previous report:	Annual report, April 2015
Key staff:	
Location of project:	University of Nottingham & NIAB EMR
Industry Representative:	Marion Regan, Hugh Lowe farms
Date project commenced:	12 May 2014
Date project completed (or expected completion date):	30 April 2017

GROWER SUMMARY

Headline

- Progress is being made to develop the use of hyperspectral imaging to identify early symptoms of strawberry plant stress before it is visible to the human eye.

Background and expected deliverables

The aim of this research project is to automatically detect symptoms of stress (such as onset of disease or drought) of strawberry plants at an early stage, before symptoms are visible to the human eye. The intention is to detect indicators of stress in strawberry plant physiology using hyperspectral image analysis, a non-invasive technique. Finding early indicators of stress will aid crop management through timely intervention with appropriate treatments in order to reduce potential losses to the quantity and quality of the strawberry crop. To do this, novel image analysis methods will be developed to aid data measurement from the images, and a suitable analysis method will be identified to enable use of hyperspectral data as a predictor.

The images will be collected using hyperspectral cameras, and will include both spatial information (the location of the pixels in the image) and spectral information (the narrow bands of contiguous wavelengths from visible light to near infra-red light). The plants will be imaged at NIAB East Malling Research (NIAB EMR) and The University of Nottingham.

Once the images have been captured, the strawberry plants need to be identified in the images using a technique known as ‘segmentation’. This means labelling objects (leaves, in this case) in the image by finding similar properties such as colour, shape or texture. Once the leaves have been located in the images, the hyperspectral information can then be extracted and analysed over time.

Summary of the project and main conclusions

In the past year, work has been carried out through the collection of experimental datasets, and the development of image segmentation techniques. The data collected during the summer of 2015 involved two-spotted spider mite, powdery mildew and two drought sessions. Four varieties were imaged daily (spider mite, drought) or on alternating days (in the case of mildew) until visible signs appeared.

The challenge for the image analysis is selecting areas of the images from which to use the hyperspectral data, to maximise its quality. A novel segmentation approach based on a popular ‘Level Set’ technique is being developed to segment the leaves. Level sets are a mathematical way of representing object boundaries in images. In combination with the level sets approach, a shape constraint has been introduced because the level sets alone could not

reliably identify overlapping leaves. Also by using the shape constraint the aim is that angled leaves will not fit the shape criteria and not be selected for inclusion in the data analysis, as leaves facing away from the camera will likely affect final data quality. It is anticipated that this combination of approaches will yield high quality data for analysis via the reduction of noise in the dataset.

3D reconstruction has also been researched to find the depth of the leaves and possibly model their orientation; however this technique is still ongoing. The next 3-6 months will involve finishing the segmentation process to improve the accuracy and also to analyse the time series data with different predictive techniques (VI, SiVM, machine learning).

Financial benefits

- For this interim report it is not appropriate to undertake a cost/benefit analysis.

Action points for growers

- There are no action points for growers at this stage of the project.