Grower Summary

SF/TF 170

Detection of Strawberry Disease with Deep Learning and Computer Vision

Annual 2019

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Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.
Before using all pesticides check the approval status and conditions of use.
Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the AHDB Horticulture office (hort.info.@ahdb.org.uk), quoting your AHDB Horticulture number, alternatively contact AHDB Horticulture at the address below.

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Project title:	Detection of Strawberry Disease with Deep Learning and Computer Vision
Project number:	SF TF 170
Project leader:	Dr B. Al-Diri, University of Lincoln, Supervisor, Dr A Hunter, University of Lincoln, Supervisor, Dr X. Xu, NIAB EMR, Supervisor
Report:	Annual Report, Year 1
Previous report:	None
Key staff:	Wayne Andrews
Location of project:	University of Lincoln, Riseholme & Brayford Campus, NIAB EMR
Industry Representative:	Richard Harnden, Berry Garden Growers Ltd
Date project commenced:	07/11/2018

GROWER SUMMARY

Headline

Improve strawberry crop yield by embracing automated disease detection powered by Computer Vision and Deep Learning.

Background

The soft fruit industry in the UK is a multi-million-pound industry with demand doubling over the past 20 years. With the average price of a punnet of strawberries (400g) costing roughly £2 for the same period, representing a real term fall in price. Growers are having to be ever more efficient with their crop if this trend is to be maintained. For most of the peak-season (April – October) the UK is almost self-sufficient with ~90% of the crop grown under cover to extend the season from what is once was (June-July). With the UK consuming 131,000 tonnes of strawberries between 2018-19 and spending more than £653 million (FarmingUK, 2019), there is a great need to ensure the crop is healthy in order to meet the demand. Should the UK need to rely on imported strawberries it is estimated the price would increase 50% with farmers arguing negative impacts on the environment also with transporting the crop from mainland Europe and beyond to the UK (Wheeler, 2018)

With the ever-increasing surge towards automation in the Agri-Tech industry coupled with the looming potential shortfall in labour (Doward, 2019), there is an opening for autonomous systems for the soft fruit industry. Growers control disease in strawberry crops and extend shelf life of picked fruit using a range of crop protection products, however there are ever increasing restrictions placed upon what can be used, some herbicides and pesticides have been completely phased out due to new regulations. This has left an industry looking to new ways to maintain a healthy crop and produce a profitable yield.

Current crop disease management is accomplished in a very analogue manner with skilled agronomists having to painstakingly inspect the crop at a grower's site, it is hoped that by using Deep Learning this work can be made easier by gathering data from the entire crop traversed and highlighting areas that may require further attention or intervention.

Deep learning is a subset of the larger field of machine learning, vast neural networks comprised of many layers inspired by the way the human brain processes information, if given enough data to learn from a deep learning system can allow a machine to solve complex problems. There are deep learning systems everywhere around us, from virtual assistants

such as Amazon's Alexa, Apple's Siri or Microsoft's Cortana to vision systems for pilotless drones or autonomous vehicles. (Marr, 2018)

Over the past few years there has been a rapid surge in deep learning coupled with higher resolution imaging sensors becoming more readily available at more affordable prices. Solutions are becoming available to move towards a more automated management strategy to better utilise highly trained staff and deploy them where needed.

Botrytis alone is thought to be responsible for as much as €10 billion in lost crop globally each year, Phytophthora causes crown and root rots in strawberries and can swiftly progress to plant death, in turn reducing profitable yield (FungiAlert, 2019)

Powdery Mildew attacks the leaves, flowers and fruit of the strawberry, and can result in yield losses from 20% to 70% of crop potential (Avice M Hall, 2017). It is almost impossible to have the plants under continuous surveillance and with the current political climate combined with the dropping value of the pound there are less seasonal workers from the EU available to monitor, harvest and maintain healthy crops. Estimates of labour shortages as high as 30% have been reported on some farms with the Home Office estimating ~80,000 positions needed filling in the 2019 season, mostly by workers from other EU countries (Doward, 2019).

Summary

Using fruit that has been inoculated by three different commonly occurring fruit rot pathogens (Rhizopus, Mucor and Botrytis), this project has so far demonstrated the ability to use existing deep learning models to detect disease present on post-harvest fruit. This type of detection would be useful in a packing environment, checking punnets of fruit as they pass by on a conveyor and rejecting those which are potentially unsuitable for sale. Using a state-of-the-art 'Mask R-CNN' model it was possible to achieve 78.54% accuracy for instance detection (instance detection not only detects the presence of a class within an image, it also detects the individual instances of each class), based on training accomplished with a very small amount of data. Classification of disease present in an image of a strawberry was giving accuracies of upto 92.05% using an increased amount of data. A dataset of powdery mildew has been collected covering the period from inoculation to visual symptoms becoming present, this dataset is currently in the labelling stage.

Financial Benefits

Once completed this project will enable growers to monitor their crops more effectively and address potential problems before issues spread to neighbouring crops. It may also be possible to visually screen fruit as it is packed and help identify fruit that is showing signs of infection that may drastically reduce shelf life.

Action Points

There are no grower action points at this early stage of the project.