Automatic Detection of Regions in Spinach Canopies Responding to Soil Moisture Deficit Using Combined Visible and Thermal Imagery

Title	Automatic Detection of Regions in Spinach Canopies Responding to Soil Moisture Deficit Using Combined Visible and Thermal Imagery
Title (native language)	
Category	• Recording or mapping technology
Short summary for practitioners (Practice abstract) in English)	Thermal imaging has been used in the past for remote detection of regions of canopy showing symptoms of stress, including water deficit stress. Stress indices derived from thermal images have been used as an indicator of canopy water status, but these depend on the choice of reference surfaces and environmental conditions and can be confounded by variations in complex canopy structure. Therefore, in this work, instead of using stress indices, information from thermal and visible light imagery was combined along with machine learning techniques to identify regions of canopy showing a response to soil water deficit. Thermal and visible light images of a spinach canopy with different levels of soil moisture were captured. Statistical measurements from these images were extracted and used to classify between canopies growing in well-watered soil or under soil moisture deficit using Support Vector Machines (SVM) and Gaussian Processes Classifier (GPC) and a combination of both the classifiers. The classification results show a high correlation with soil moisture. We demonstrate that regions of a spinach crop responding to soil water deficit can be identified by using machine learning techniques with a high accuracy of 97%. This method could, in principle, be applied to any crop at a range of scales.
Short summary for practitioners	
Website	
Audiovisual material	
Links to other websites	
Additional comments	
Keywords	Plant production and horticulture	Soil management / functionality
Additional keywords	
Geographical location (NUTS)	EU
Other geographical location	
Cropping systems	
Field operations	Irrigation	Crop and soil scouting
SFT users	Farmer	Contractor

Education level of users	Secondary education	Apprenticeship or technical school education	University education
Farm size (ha)	0-2	2-10	10-50	50-100

Scientific article

Title	Automatic detection of regions in spinach canopies responding to soil moisture deficit using combined visible and thermal imagery
Full citation	Raza, S.-E.-A.; Smith, H.K.; Clarkson, G.J.J.; Taylor, G.; Thompson, A.J.; Clarkson, J.; Rajpoot, N.M. (2014). PLoS ONE, DOI:10.1371/journal.pone.0097612

Effects of this SFT

Productivity (crop yield per ha)	No effect
Quality of product	No effect
Revenue profit farm income	Some increase
Soil biodiversity	No effect
Biodiversity (other than soil)	No effect
Input costs	No effect
Variable costs	No effect
Post-harvest crop wastage	No effect
Energy use	Some decrease
CH4 (methane) emission	No effect
CO2 (carbon dioxide) emission	No effect
N2O (nitrous oxide) emission	No effect
NH3 (ammonia) emission	No effect
NO3 (nitrate) leaching	No effect
Fertilizer use	No effect
Pesticide use	No effect
Irrigation water use	Some decrease
Labor time	No effect
Stress or fatigue for farmer	No effect
Amount of heavy physical labour	No effect
Number and/or severity of personal injury accidents	No effect
Number and/or severity of accidents resulting in spills property damage incorrect application of fertiliser/pesticides etc.	No effect
Pesticide residue on product	No effect
Weed pressure	No effect
Pest pressure (insects etc.)	No effect
Disease pressure (bacterial fungal viral etc.)	No effect

Information related to how easy it is to start using the SFT

This SFT replaces a tool or technology that is currently used. The SFT is better than the current tool	agree
The SFT can be used without making major changes to the existing system	no opinion
The SFT does not require significant learning before the farmer can use it	disagree
The SFT can be used in other useful ways than intended by the inventor	no opinion
The SFT has effects that can be directly observed by the farmer	no opinion
Using the SFT requires a large time investment by farmer	no opinion
The SFT produces information that can be interpreted directly	disagree

[View this technology on the Smart-AKIS platform.](#)

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