Salinity Stress Assessment on Vegetation Cover in Arid Regions Using Visible Range Indices of True Color Aerial UAV/Drone Images

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Introduction

Date palm (*Phoenix dactylifera L.*) is one of the most important plant growing in arid and semi-arid regions, where it has a social, cultural, economic and nutritious importance (Allbed et al., 2017; Patankar et al., 2016). Although date palm can be ranked as the highest salt tolerance plant among fruit crop, extreme salinity can negatively affect its growth, yield and fruit quality. Inadequate annual rainfall of arid regions have stressed and rapidly decreased date palm plantation due to salinity and drought (Patankar et al., 2016). This rapid spread of salinity has risen the necessity for accurate, cost-effective and timely monitoring method to update the information about the salinity stressed date palm trees. Remote sensing techniques have been recognized as accurate, cost efficient, labor-saving and low time consuming (Al-Mulla 2010; Mulder et al., 2011). The applications of Unmanned aerial vehicles (UAV) in agriculture as a remote sensing platform have been considered as a future key factor for the growers and researchers, which can develop precision agriculture (PA) and field-based crop phenotyping (FBP) (Jannoura et al., 2015; Yang et al., 2017). The main purpose of this project was to use using visible range indices of UAV color images for the assessment of the salinity stress on date palm in an a arid country of Oman.

Materials and Methods

Eight sites with different salinity levels of irrigation water and different distances from sea shore have been selected. Soil samples have been collected from five randomly selected locations in each site. Samples of the irrigation water used in each site were also collected. The soil and water samples were chemically analyzed in the lab to measure electrical conductivity (EC), pH, and mineral cations concentrations using Inductivity Coupled Plasma (ICP) apparatus. In addition, moisture content and texture of the soil samples were obtained. A UAV (phantom-3-pro, DJI, China) with a digital color camera (12.4 Mega pixel 1/2.3" CMOS, DJI, China) was used to take the whole sites images and close up images of five selected date palm trees in each site. Green leaf algorithm index (GLAI) and leaf area index (LAI) were used to determine canopy attributes (Chianucci et al., 2016). The Environment for Visualizing Images (ENVI) software were used for image pre-processing. Ortho-rectification (Fig.1) was done for each site image in ENVI using Ground Control Points (GCPs) and Replacement Sensor Model (RSM).

$$GLAI = \frac{2G - R - B}{2G + R + B} \qquad LAI = -\frac{\ln(1 - Cc)}{\Omega(0) x\, G(0)}$$

where G, R and B are the digital numbers of the green, red and blue channel of the image, Cc is the obtained canopy cover, Ω(0) is the foliage clumping, and G(0) is the foliage projection function.

Outcomes

Through the use of UAV/Drones platform and true color aerial images, the preliminary results of this study showed that this hi-tech approach can open a state of the art solution in assessing and managing one the most sever environmental problem affecting the arid- regions namely soil/water salinity which is the number one cause of land degradation in this region.

Fig.1 Orthorectification of one site's satellite image.

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