ASSESSMENT OF THE SPECTRAL CHARACTERISTICS OF DIFFERENT PHYSIOLOGICAL STAGES OF SOME OLIVE CVS. AND ITS RELATION WITH PRODUCTIVITY

By

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B.Sc. Agric. Sc. (General Division), Tanta Univ.(2011)

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Approval Sheet

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ABSTRACT

Amany Farouk Abdelhameed ELwesemy: Assessment of the Spectral Characteristics of Different Physiological Stages of some Olive cvs. and its Relation with Productivity. M.Sc. Thesis, Arid Land Agricultural Graduated Studies and Research Institute, Agriculture in Desert and Salt Affected Areas, Faculty of Agriculture, Ain Shams University, 2016.

Remote sensing satellite imagery is the tool to obtain synoptic, multi temporal, dynamic and timely efficient information about any target on Earth. The main objective of the current study is to use space born and field spectroradiometric measurements remotely sensed data to identify spectral signature of different olive cultivars, to link productivity for the olive crop with the different vegetation indices that were calculated from spectral characteristics to predict productivity of each cultivar based on statistical empirical models and finally, to produce olive productivity map from RapidEye satellite image.

This study was carried out in Wadi EL-Natrun city, EL-Behira governorate during the season of 2014. Observation site was thirty feddans cultivated by three cultivars: Picual, Manzanillo and Kalamata. Field spectroradiometric measurements were carried out for the different growth stages (dormancy, flowering, fruit sat, mature and ripening). As the first step of the observation, spectral reflectance pattern of the three cultivars was observed. It was found three cultivars ,the highest spectral reflectance in near infrared bands was Manzanillo cultivar, then Picual cultivar while the lowest reflectance of near infrared was found with Kalamata cultivar. Spectral reflectance data that are released from the different spectral domains (visible, near infra-red and short wave infrared) and vegetation indices that are calculated from spectral reflectance data were used with yield data to produce yield Simple Linear Regression models using (SPSS) software.

Normalized Difference Vegetation Index (NDVI), Modified Chlorophyll Absorption Ration Index (MCARI), Triangular Vegetation Index (TVI), Modified Chlorophyll Absorption Ration Index 1 (MCARI1), Modified

Chlorophyll Absorption Ration Index2 (MCARI2), Modified Triangular Vegetation Index2 (MTVI2) Chlorophyll Index (CI) and spectral reflectance from the different spectral domains were for the three cultivars in all stages were used as estimators in the modeling process. It was found that the optimal growth stage for yield prediction was mature stage with Picual and kalamata cultivars while the optimal was fruit sat stage in the case of Manzanillo cultivar. The lowest correlation coefficient was found with dormancy stage with the three observed cultivars. Finally, a yield map was produced through the application of the generated yield prediction models on Rapid- Eye satellite image.

Keywords:

Olive tree, Olive cvs., Spectroradiometer, Spectral Characteristics, Vegetation Indices ,Yield prediction.

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LIST OF ABBREVIATIONS

ABBREVIATION	Mean
ANOVA	Analysis of variance
CI	Chlorophyll Index
EMS	Electro-magnetic spectrum
Eq	Equation
ETM+	Enhanced Thematic Mapper Plus
GPP	Gross primary production
GPS	Global Positioning System
Ha	Hectare
IR	Infrared
Kg	Kilogram
MCARI	Modified Chlorophyll Absorption Ration Index
MCARI1	Modified Chlorophyll Absorption Ration Index1
MCARI2	Modified Chlorophyll Absorption Ration Index2
MODIS	Moderate Resolution Imaging Spectroradiometer
MTVI2	Modified Triangular Vegetation Index2
NDVI	Normalized Difference Vegetation Index
NIR	Near infrared
Nm	Nanometer
NPP	Net primary production
PLSR	Partial Least Squares Regression
SLR	Simple linear regression
SPOT	Système pour l'observation de la Terre
SPSS	Statistical Package for Social Science
SWIR	Shortwave Infrared
SWIR1	Shortwave Infrared1
SWIR2	Shortwave Infrared2
TM	Thematic mapper band
TVI	Triangular Vegetation Index
VIs	Vegetation Indices

INTRODUCTION

As statistics of 2014, the total Olive (***Olea europaea.L*)** area in Egypt is 202743 feddans (14353 feddans in old lands produce about 76017 tons and 188390 feddans in newly reclaimed lands produce about 487053tons).
(http://www.agricultureegypt.com/ArticleDetails.aspx?CatID=081d64e8-d4d3-43c5-9115-89229e6ddfa0&ID=28218134-827c-4bef-99d1 1690a11cfa98). The most important olive producing areas in Egypt are the west coast and the province of Fayoum, oasis of new valley, Northern Sinai and Wadi EL-Natrun and western province of EL-Behira governorate. In spite of importance of olive cultivation in Egypt for the national economy, olive spectral characteristics and its spatial distribution overall the country was never observed by remote sensing techniques. Moreover, there is no statistical models to predict olive productivity.

Field Spectroradiometer is used to recognize the spectral reflectance and spectral characteristics of Olive cultivars. Spectral characteristics could be used as estimators for crop yield through empirical statistical model. Modeling process is based on Vegetation Indices(VIs) such as Normalized Difference Vegetation Index(NDVI), Modified Chlorophyll Absorption Ration Index(MCARI), Triangular Vegetation Index(TVI), Modified Chlorophyll Absorption Ration Index -1(MCARI-1), Modified Chlorophyll Absorption Ration Index-2(MCARI-2), Modified Triangular Vegetation Index-2(MTVI2) Chlorophyll Index(CI). These spectral parameters could be calculated from remote sensing satellite data as well as remotely sensed ground observation tools. Based on the generated models, crop yield map could be produced using Rapid Eye image. The study was carried out in Olive farm in Wadi El-Natrun during the whole season of 2014.

REVIEW OF LITERATURE

Remote sensing is the ability to measure properties of an object without being in contact with it. It could be also identified as the science to detect, measure, record and analyze energy in a selected portion of the electromagnetic spectrum. Remote sensing techniques, in particular, multispectral visible and Infra red reflectance and emission provides an instantaneous, nondestructive, and quantitative assessment of crops ability to intercept radiation and photosynthesize **Ahmed *et al*., (2011).** Estimation of crop acreage, assessment of crop biochemical and biophysical parameters and assessment of crop physiological characteristics started long time ago using traditional methods, however remote sensing techniques could facilitate and accelerate this work in costly effective and timely efficient approach. A lot of studies and observations have been carried in the trend of using remote sensing to study vegetation cover in general or specific.

The importance of Olive as a strategic crop in arid and semi-arid areas of the Mediterranean basin we highlighted over decades through many studies. **(Loukas and Krimbas, 1983)** reported that the cultivation of olive trees started in the Mediterranean basin some 6000 years ago. They reported that the olive tree, *Olea europaea L.*, is adapted to the Mediterranean climate and produces fruit and oil. Both are important commodities in world markets. This fact again confirmed by **De Graaff and Eppink, (1999); Loumou and Giourga, (2003); Villalobos *et al*., (2012)** who mentioned that Olive *(Olea europaea L.)* is one of the most ancient cultivated fruit trees in the Mediterranean basin where it plays a fundamental role by integrating agriculture, environment and landscape into a complex system.