



Identifying Soil and Plant Nutrition Factors Affecting Yield in Irrigated Mature Pistachio Orchards

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ABSTRACT

The main objective of this study was to evaluate the potential use of a hybrid Genetic Algorithm-Artificial Neural Network (GA-ANN) method for predicting pistachio yield and for identifying the determinant factors affecting pistachio yield in Rafsanjan region, Iran. A total of 142 pistachio orchards were selected randomly and soil samples were taken at three depths. Besides, water samples and leaves from branches without fruit were taken in each sampling point. Management information and pistachio yields were achieved by completing a questionnaire. Primarily, 58 variables affecting pistachio yield were measured, and then 26 out of them were selected by minimizing mean square error (MSE) using a feature selection (FS) method. The results showed that the accuracy of the method was acceptable. Furthermore, the sensitivity analysis showed that the main determinant features affecting the pistachio yield were the irrigation water amount, leaf phosphorus, soil soluble magnesium, electrical conductivity (EC), and leaf nitrogen.

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Crop yield prediction; feature selection; non-linear modeling; pistachio production optimization

Introduction

As complex interactions among different factors such as topography, soil and water properties, climatic conditions and management practices may affect crop yield (Kravchenko et al. 2005), knowing the factors that affect and determine yield as well as being able to early predict the yield of crops are of paramount importance.

Several models and algorithms have been developed to predict crop yield and to identify important factors influencing the yield. Cross-correlation and multiple linear regression (MLR) methods are commonly used in this regard (Gutiérrez et al. 2008; Huang et al. 2010; Kravchenko and Bullock 2000; Park, Hwang, and Vlek 2005). However, the obtained results are often not satisfactory. In other words, MLR analysis is limited to describing linear relationships between crop parameters and site variables, and the results may be misleading when these relationships are not linear (Besalatpour et al. 2013; Kitchen et al. 2003; Shirani et al. 2015). Therefore, using nonlinear methods mainly artificial neural networks (ANNs) for crop yield prediction have recently considered in many studies (Effendi, Ramli, and Ghani 2010; Folberth et al. 2012; Kaul, Hill, and Walthall 2005; Miao, Mulla, and Robert 2006; Papageorgiou et al. 2013; Papageorgiou, Markinos, and Gemtos 2011; Sharma, Sharma, and Kasana 2007; Shirani et al. 2015).

ANN is a simulation method which is modeled based on brain system and neural network of organisms and has a high capability for simulation and detection of complex and nonlinear

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