Journal of Water and Soil
Vol. 30, No. 3, Jul.-Agu. 2017, p. 835-845

نشریه آب و خاک (علوم و صنایع کشاورزی)
جلد ۳۰، شماره ۳، مرداد – شهریور ۱۳۹۶، ص. ۸۴۵-۸۳۵

Study of Potassium Status and Evaluating Chemical Extractants for Estimating Available K in Some Soils of Olive Orchards of Fars Province

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Received: 03-05-2016
Accepted: 11-01-2017

Introduction: Evaluation of the nutrient status in soil is important from the nutritional, environmental, and economical aspects. Potassium is an essential element for plant growth and is a dynamic ion in the soil system. Soil testing is a useful tool that can help to ensure the efficient use of applied plant nutrients. Soil tests measure the quantity of a nutrient element that is extracted from a soil by a particular chemical extracting solution. The measured quantity of extractable nutrient in soil is then used to predict the crop yield response to application of the nutrient as fertilizer, manure, or other amendments. Over the years, many different soil testing procedures and extracting solutions were evaluated in an effort to identify a method that provides the most reliable prediction of crop yield response to nutrient application. It was determined that some soil testing procedures are best suited for particular soil types and climatic regions, whereas other soil testing procedures are better suited for different soil types and climates. Olive is a strategic and economic product in Iran. Fars province is the second largest olive producer in Iran. There is no general information about K status in the soils and olive trees of the Fars province as well as no introduced appropriate K extractants for theses soils. Therefore, the objectives of this study were: i) evaluating potassium status of some soils of olive orchards of Fars province and ii) introducing appropriate k extractants for extracting available K in these soils.

Materials and Methods: Fars province, with an area of 122000 km^2 is located in southern Iran. The elevation varies from 500 m to 4400 m above mean sea level. Based on the information regarding olive orchards of Fars province, 13 typical olive orchards were selected. 26 surface (0-30 cm) and subsurface (30-60 cm) soil samples were taken. Physiochemical properties of the soil samples were determined based on standard methods. Soil reaction, texture, electrical conductivity, calcium carbonate, organic carbon, and cation exchange capacity were identified. The 12 K extracting solutions were 1M NaCl, 2M NaCl, 0.01M $CaCl_2$, Morgan, AB-DTPA, 1M NH_4OAC, 0.25M NH_4OAC, 1M NaOAC, 2M HCl, 0.1M HNO_3, 1M HNO_3, and 0.025M H_2SO_4. The K contents of leaf samples were determined in 1g of each sample. The samples were dried and then ashed in 450°C for 4 h. 2M HCl was used to digest the samples. Potassium in all the filtrated extracts were then analyzed using flame photometer.

Results and Discussion: The all soils were calcareous (average of 48.7 and 50.2% calcium carbonate equivalent in surface and subsurface, respectively) with pH in range of 7.05-7.8. The textural classes were loam, clay loam, and sandy loam. The results showed that the concentrations of K extracted varied widely with the used method, because each extractant remove different portions of K. Among the 12 tested methods, boiling 1 mol/L HNO_3 extracted highest amount of K (mean 696.1 mg/kg and range of 203.3-1893 mg/kg) which extracted soluble, exchangeable, and non-exchangeable potassium forms due to its high concentration of H^+ and 2mol/L HCl removed the lowest amount of K (mean 32.7 mg/kg and range of 2.6-148.5 mg/kg). Correlation coefficients between K extracted by 12 extractants were determined. The correlation between potassium extracted by all the chemical methods was positive and significant except for boiling 1M HNO_3. Between all tested extractants, 0.25M NH_4OAC and 1M NH_4OAC had the highest correlation ($p \leq 0.01$, r= 0.999). The relationship between soil potassium and potassium concentration in olive leaves were evaluated. Maximum correlation between leaf K and extracted soil K were noticed in 2M NaCl, 0.25M NH_4OAC, 1M NaOAC, and AB-DTPA (r=0.721, 0.718, 0.717, and 0.714, respectively) and the minimum correlation was noticed in 1M HNO_3 (r= 0.661).

Conclusion: The concentrations of K extracted varied widely with applied method, because of desorbing different portions of K by each method, different concentrations of each extracting solution, and the different times of equilibration. On average, the quantity of extracted K by 12 methods were in the following order: boiling 1M HNO_3> 1M NH_4OAC> 0.25M NH_4OAC> AB-DTPA> morgan> 0.1 HNO_3> 0.025M H_2SO_4> 0.01M $CaCl_2$> 1M NaCl> 1M NaOAC> 2M NaCl> 2M HCl. This study showed that 2M NaCl, 0.25M NH_4OAC and 1M NaOAC would be suitable as soil testing methods for determining available K for olive in the soils of Fars

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province. These extractants were the best because of high correlation with plants potassium. In addition, advantages of these extractants are low cost and simplicity. As a recommendation, using of K fertilizers in most olive orchards of the province will improve quantity and quality of the yield.

Keywords: Available potassium, Chemical extractants, Nutrition management, Olive orchards